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## IDP Facilitator / LEED Consultant: Kath Williams + Associates

<table>
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<tr>
<td>Kath Williams</td>
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## M-E-P Engineers: ACE / AEI

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<th>Name</th>
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<tr>
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## Lab Consultant: RFD

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<tr>
<td>Terry Brown</td>
<td>Laboratory Consultant</td>
<td><a href="mailto:tdb@rfd.com">tdb@rfd.com</a></td>
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## Civil, Geotech, Transportation, and Survey Engineers: DOWL HKM

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<tr>
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## Structural Engineer: Morrison-Maierle

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<tr>
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## Landscape Architect: Land Design

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<th>Name</th>
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<tr>
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<td>406.655.3550</td>
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## Acoustic Consultant: Big Sky Acoustics

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<th>Name</th>
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<tr>
<td>Sean Connolly</td>
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## Technology Consultant: Access Consulting

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<tr>
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## Parking Consultant: Walker Parking

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<tr>
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## Audio Visual Design: Onpoint Designs

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<tr>
<td>Jeff Sanderson</td>
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<td>360.352.3808</td>
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</table>
**Performance Bond**

**CONTRACTOR:**  
(Name, legal status and address)  
« »

**SURETY:**  
(Name, legal status and principal place of business)  
« »

**OWNER:**  
(Name, legal status and address)  
«Department of Administration, State of Montana»  
«P.O. Box 200103  
1520 East Sixth Avenue  
Helena, MT  59620-0103»

**CONSTRUCTION CONTRACT**  
Date: « »  
Amount: $ « »  
Description:  
(Name and location)  
«New Parking Facility - Montana State University»  
«Corner of S. 7th Ave. and W. Grant.»

**BOND**  
Date: « »  
Amount: $ « »  
Modifications to this Bond:  
None  
See Section 16

**CONTRACTOR AS PRINCIPAL**  
Company:  
(Corporate Seal)  
Signature:  
Name and Title:  
(Any additional signatures appear on the last page of this Performance Bond.)

**SURETY**  
Company:  
(Corporate Seal)  
Signature:  
Name and Title:  
(Any additional signatures appear on the last page of this Performance Bond.)

**(FOR INFORMATION ONLY — Name, address and telephone)**  
**AGENT or BROKER:**

**OWNER'S REPRESENTATIVE:**  
(Architect, Engineer or other party:)  
«Russ Katherman, P.E.»  
«P.O. Box 200103  
1520 East Sixth Avenue  
Helena, MT  59620-0103»

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety’s obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor’s performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner’s notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety’s receipt of the Owner’s notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner’s right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety’s obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety’s expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner’s concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.
§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for
.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
.2 additional legal, design professional and delay costs resulting from the Contractor’s Default, and resulting from the actions or failure to act of the Surety under Section 5; and
.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety’s liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions
§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.
§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

<table>
<thead>
<tr>
<th>CONTRACTOR AS PRINCIPAL</th>
<th>SURETY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company:</td>
<td>Company:</td>
</tr>
<tr>
<td>(Corporate Seal)</td>
<td>(Corporate Seal)</td>
</tr>
</tbody>
</table>

Name and Title:  
Address:  

Name and Title:  
Address:  

Signature:  

Signature:  

User Notes:  

(1884959342)
### AIA Document A312™ – 2010 Payment Bond

**CONTRACTOR:**
(Name, legal status and address)

| « »« » | « »
| « » | « »

**SURETY:**
(Name, legal status and principal place of business)

| « »« » | « »
| « » | « »

**OWNER:**
(Name, legal status and address)

| «Department of Administration, State of Montana« » | « »
| «P.O. Box 200103
1520 East Sixth Avenue
Helena, MT 59620-0103» | « »

**CONSTRUCTION CONTRACT**

Date: «»
Amount: $ « »
Description:
(Name and location)
| «New Parking Facility - Montana State University» «Corner of S. 7th Ave. and W. Grant.» |

**BOND**

Date: «»
(Not earlier than Construction Contract Date)
Amount: $ « »
Modifications to this Bond: « » None « » See Section 18

**CONTRACTOR AS PRINCIPAL**

Company: (Corporate Seal)

| « »« » | « »« » | « »« » | « »« » |
| « » | « » | « » | « »

Signature:
Name and Title:
(Any additional signatures appear on the last page of this Payment Bond.)

**SURETY**

Company: (Corporate Seal)

| « »« » | « »« » | « »« » | « »« » |
| « » | « » | « » | « »

Signature:
Name and Title:

**AGENT or BROKER:**

| « » | « » | « » |
| « » | « » | « » |

**OWNER’S REPRESENTATIVE:**

(Architect, Engineer or other party:)

| «Russ Katherman, P.E.» | « » « » « » « » « »
| «P.O. Box 200103
1520 East Sixth Avenue
Helena, MT 59620-0103» | « » « » « » « » « »

**ADDITIONS AND DELETIONS:**
The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An Additions and Deletions Report that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

**ELECTRONIC COPYING** of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.
§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety’s obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner’s property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety’s expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety’s obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor, .1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and .2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant’s obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety’s expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety’s failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney’s fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety’s total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney’s fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner’s priority to use the funds for the completion of the work.
§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic’s lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms “labor, materials or equipment” that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL          SURETY
Company:  (Corporate Seal)  Company:  (Corporate Seal)
Signature:  « »  Signature:  « »
Name and Title:  « »« »  Name and Title:  « »« »
Address:  « »  Address:  « »
Standard Form of Agreement Between Contractor and Subcontractor

AGREEMENT made as of the TBD day of TBD in the year TBD
(In words, indicate day, month and year)

BETWEEN the Contractor: Martel Construction, Inc.
(Name, address and other information)
1203 South Church (406) 586-8585
Bozeman, MT 59715 (406) 586-8646

and the Subcontractor: Company
(Name, address and other information)
Address - -
City, State, Zip - -

The Contractor has made a contract for construction dated: TBD

With the Owner: Montana State University
(Name, address and other information)
PO Box 172760
Bozeman, MT 59717-2760

For the following Project: MSU NAIC Parking Structure
(Include detailed description of Project, location and address)

0
0

which Contract is hereinafter referred to as the Prime Contract and which provides for the furnishing of labor, materials, equipment and services in connection with the construction of the Project. A copy of the Prime Contract, consisting of the Agreement Between Owner and Contractor (from which compensation amounts may be deleted) and the other Contract Documents enumerated therein has been made available to the Subcontractor.

The Architect for the Project is: A&E Architects
(Name, address and other information)
608 N 29th St. 406-248-2633
Billings, MT 59101 - -

The Contractor and the Subcontractor agree as follows


WARNING: Unlicensed photocopying violates U.S. copyright laws and will subject the violator to legal prosecution.
ARTICLE 1 THE SUBCONTRACT DOCUMENTS

1.1 The Subcontract Documents consist of (1) this Agreement; (2) the Prime Contract, consisting of the Agreement between the Owner and Contractor and the other Contract Documents enumerated therein; (3) Modifications issued subsequent to the execution of the Agreement between the Owner and Contractor; whether before or after the execution of this Agreement; (4) other documents listed in Article 16 of this Agreement; and (5) Modifications to this Subcontract issued after execution of this Agreement. These form the Subcontract, and are as fully a part of the Subcontract as if attached to this Agreement or repeated herein. The Subcontract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Subcontract Documents, other than Modifications issued subsequent to the execution of this Agreement, appears in Article 16.

1.2 Except to the extent of a conflict with a specific term or condition contained in the Subcontract Documents, the General Conditions governing this Subcontract shall be the edition of AIA Document A201, General Conditions of the Contract for Construction, current as of the date of this Agreement.

1.3 The Subcontract may be amended or modified only by a Modification. The Subcontract Documents shall not be construed to create a contractual relationship of any kind (1) between the Architect and the Subcontractor, (2) between the Owner and the Subcontractor, or (3) between any persons or entities other than the Contractor and Subcontractor.

1.4 The Subcontractor shall be furnished copies of the Subcontract Documents upon request, but the Contractor may charge the Subcontractor for the reasonable cost of reproduction.

ARTICLE 2 MUTUAL RIGHTS AND RESPONSIBILITIES

2.1 The Contractor and Subcontractor shall be mutually bound by the terms of this Agreement and, to the extent that the provisions of the edition of AIA Document A201 current as of the date of this Agreement apply to this Agreement pursuant to Paragraph 1.2 and provisions of the Prime Contract apply to the Work of the Subcontractor, the Contractor shall assume toward the Subcontractor all obligations and responsibilities that the Owner, under such documents, assumes toward the Contractor, and the Subcontractor shall assume toward the Contractor all obligations and responsibilities which the Contractor, under such documents, assumes toward the Owner and the Architect. The Contractor shall have the benefit of all rights, remedies and redress against the Subcontractor which the Owner, under such documents, has against the Contractor, and the Subcontractor shall have the benefit of all rights, remedies and redress against the Contractor which the Owner, under such documents, has against the Owner, insofar as applicable to this Subcontract. Where a provision of such documents in inconsistent with a provision of this Agreement, this Agreement shall govern.

2.2 The Contractor may require the Subcontractor to enter into agreements with Sub-subcontractors performing portions of the Work of this Subcontract by which the Subcontractor and the Sub-subcontractor are mutually bound, to the extent of the Work to be performed by the Sub-subcontractor, assuming toward each other all obligations and responsibilities which the Contractor and Subcontractor assume toward each other and having the benefit of all rights, remedies and redress each against the other which the Contractor and Subcontractor have by virtue of the provisions of this Agreement.
ARTICLE 3 CONTRACTOR

3.1 SERVICES PROVIDED BY THE CONTRACTOR
3.1.1 The Contractor shall cooperate with the Subcontractor in scheduling and performing the Contractor's Work to avoid conflicts or interference in the Subcontractor's Work and shall expedite written responses to submittals made by the Subcontractor in accordance with Paragraph 4.1 and Article 5. As soon as practicable after execution of this Agreement, the Contractor shall provide the Subcontractor copies of the Contractor's construction schedule and schedule of submittals, together with such additional scheduling details as will enable the Subcontractor to plan and perform the Subcontractor's Work properly. The Subcontractor shall be notified promptly of subsequent changes in the construction and submittal schedules and additional scheduling details.

3.1.2 The Contractor shall provide suitable areas for storage of the Subcontractor's materials and equipment during the course of the Work. Additional costs to the Subcontractor resulting from relocation of such facilities at the direction of the Contractor, except as previously agreed upon, shall be reimbursed by the Contractor.

3.1.3 Except as provided in Article 14, the Contractor's equipment will be available to the Subcontractor only at the Contractor's discretion and on mutually satisfactory terms.

3.2 COMMUNICATIONS
3.2.1 The Contractor shall promptly make available to the Subcontractor information, including information received from the Owner, which affects this Subcontract and which becomes available to the Contractor subsequent to execution of this Subcontract.

3.2.2 The Contractor shall not give instructions or orders directly to the Subcontractor's employees or to the Subcontractor's Sub-subcontractors or material suppliers unless such persons are designated as authorized representatives of the Subcontractor.

3.2.3 The Contractor shall permit the Subcontractor to request directly from the Architect information regarding the percentages of completion and the amount certified on account of Work done by the Subcontractor.

3.2.4 If hazardous substances of a type of which an employer is required by law to notify its employees are being used on the site by the Contractor, a subcontractor or anyone directly or indirectly employed by them (other than the Subcontractor), the Contractor shall, prior to harmful exposure of the Subcontractor's employees to such substance, give written notice of the chemical composition thereof to the Subcontractor in sufficient detail and time to permit the Subcontractor's compliance with such laws.

3.2.5 The Contractor shall furnish to the Subcontractor within 30 days after receipt of a written request, or earlier if so required by law, information necessary and relevant for the Subcontractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property, usually referred to as the site, on which the Project is located and the Owner's interest therein.

3.2.6 If the Contractor asserts or defends a claim against the Owner which relates to the Work of the Subcontractor, the Contractor shall make available to the Subcontractor information relating to that portion of the claim which relates to the Work of the Subcontractor.

3.3 CLAIMS BY THE CONTRACTOR
3.3.1 Liquidated damages for delay, if provided for in Paragraph 9.3 of this Agreement, shall be assessed against the Subcontractor only to the extent caused by the Subcontractor or any person or entity for whose acts the Subcontractor may be liable, and in no case for delays or causes arising outside the scope of this Subcontract.
3.3.2 The Contractor's claims for services or materials provided the Subcontractor shall require:
   .1 seven day's prior written notice except in an emergency;
   .2 written compilations to the Subcontractor of services and materials provided and charges for such services and materials no later than the fifteenth day of the following month.

3.4 CONTRACTOR'S REMEDIES
3.4.1 If the Subcontractor defaults or neglects to carry out the Work in accordance with this Agreement and fails within three working days after receipt of written notice from the Contractor to commence and continue correction of such default or neglect with diligence and promptness, the Contractor may, after three days following receipt by the Subcontractor of an additional written notice, and without prejudice to any other remedy the Contractor may have, make good such deficiencies and may deduct the reasonable cost thereof from the payments then or thereafter due the Subcontractor.

ARTICLE 4 SUBCONTRACTOR
4.1 EXECUTION AND PROGRESS OF THE WORK
4.1.1 The Subcontractor shall supervise and direct the Subcontractor's Work, and shall cooperate with the Contractor in scheduling and performing the Subcontractor's Work to avoid conflict, delay in or interference with the Work of the Contractor, other subcontractors or Owner's own forces.

4.1.2 The Subcontractor shall promptly submit Shop Drawings, Product Data, Samples and similar submittals required by the Subcontract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Contractor or other subcontractors.

4.1.3 The Subcontractor shall submit to the Contractor a schedule of values allocated to the various parts of the Work of this Subcontract, aggregating the Subcontract Sum, made out in such detail as the Contractor and Subcontractor may agree upon or as required by the Owner, and supported by such evidence as the Contractor may require. In applying for payment, the Subcontractor shall submit statements based upon this schedule.

4.1.4 The Subcontractor shall furnish to the Contractor periodic progress reports on the Work of this Subcontract as mutually agreed, including information on the status of materials and equipment which may be in the course of preparation, manufacture or transit.

4.1.5 The Subcontractor agrees that the Contractor and the architect will each have the authority to reject Work of the Subcontractor which does not conform to the Prime Contract. The Architect's decisions on matters relating to aesthetic effect shall be final and binding on the Subcontractor if consistent with the intent expressed in the Prime Contract.

4.1.6 The Subcontractor shall pay for all materials, equipment and labor used in connection with the performance of this Subcontract through the period covered by previous payments received from the Contractor, and shall furnish satisfactory evidence, when requested by the Contractor, to verify compliance with the above requirements.

4.1.7 The Subcontractor shall take necessary precautions to protect properly the Work of other subcontractors from damage caused by operations under this Subcontract.

4.1.8 The Subcontractor shall cooperate with the Contractor, other subcontractors and the Owner's own forces whose Work might interfere with the Subcontractor's Work. The
Subcontractor shall participate in the preparation of coordinated drawings in areas of congestion, if required by the Prime Contract, specifically noting and advising the contractor of potential conflicts between the Work of the Subcontractor and that of the Contractor, other subcontractors or the Owner's own forces.

4.2 LAWS, PERMITS, FEES AND NOTICES

4.2.1 The Subcontractor shall give notices and comply with laws, ordinances, rules, regulations and orders of public authorities bearing on performance of the Work of this Subcontract. The Subcontractor shall secure and pay for permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Subcontractor's Work, the furnishing of which is required of the contractor by the Prime Contract.

4.2.2 The Subcontractor shall comply with Federal, state and local tax laws, social security acts, unemployment compensation acts and workers' compensation acts insofar as applicable to the performance of this Subcontract.

4.3 SAFETY PRECAUTIONS AND PROCEDURES

4.3.1 The Subcontractor shall take reasonable safety precautions with respect to performance of this Subcontract, shall comply with safety measures initiated by the Contractor and with applicable laws, ordinances, rules, regulations and orders of public authorities for the safety of persons and property in accordance with the requirements of the Prime Contract. The Subcontractor shall report to the contractor within three days an injury to an employee or agent of the Subcontractor which occurred at the site.

4.3.2 If hazardous substances of a type of which an employer is required by law to notify its employees are being used on the site by the Subcontractor, the Subcontractor's Sub-subcontractors or anyone directly or indirectly employed by them, the Subcontractor shall, prior to harmful exposure of any employees on the site to such substance, give written notice of the chemical composition thereof to the Contractor in sufficient detail and time to permit compliance with such laws by the Contractor, other subcontractors and other employers on the site.

4.3.3 If reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Subcontractor, the Subcontractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Contractor in writing. When the material or substance has been rendered harmless, the Subcontractor's Work in the affected area shall resume upon written agreement of the contractor and Subcontractor. The Subcontract Time shall be extended appropriately and the Subcontract Sum shall be increased in the amount of the Subcontractor's reasonable additional costs of demobilization, delay and remobilization, which adjustments shall be accomplished as provided in Article 5 of this Agreement.

4.3.4 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Subcontractor, the Subcontractor's Sub-subcontractors, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Subparagraph 4.3.3 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom and provided that such damage, loss or expense is not due to the sole negligence of a party seeking indemnity.
4.4 CLEANING UP

4.4.1 The Subcontractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations performed under this Subcontract. The Subcontractor shall not be held responsible for unclean conditions caused by other contractors or subcontractors.

4.4.2 As provided under Subparagraph 3.3.2, if the subcontractor fails to clean up as provided in the Subcontract Documents, the Contractor may charge the Subcontractor for the Subcontractor's appropriate share of cleanup costs.

4.5 WARRANTY

4.5.1 The Subcontractor warrants to the Owner, Architect and Contractor that materials and equipment furnished under this Subcontract will be of good quality and new unless otherwise required or permitted by the Subcontract Documents, that the Work of this Subcontract will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Subcontract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Subcontractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Subcontractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. This warranty shall be in addition to and not in limitation of any other warranty or remedy required by law or by the Subcontract Documents.

4.6 INDEMNIFICATION

4.6.1 To the fullest extent permitted by law, the Subcontractor shall indemnify and hold harmless the Owner, Contractor, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from performance of the Subcontractor's Work under this Subcontract, provided that any such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other then the Work itself), but only to the extent caused by the negligent acts or omissions of the Subcontractor, the Subcontractor's Sub-subcontractors, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph 4.6.

4.6.2 In claims against any person or entity indemnified under this Paragraph 4.6 by an employee of the Subcontractor, the Subcontractor's Sub-subcontractors, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Subparagraph 4.6.1 shall not be limited by a limitation on the amount or type of damages, compensation or benefits payable by of for the Subcontractor or the Subcontractor's Sub-subcontractors under workers' compensation acts, disability benefit acts or other employee benefit acts.

4.7 REMEDIES FOR NONPAYMENT

4.7.1 If the Contractor does not pay the Subcontractor through no fault of the Subcontractor, within seven days from the time payment should be made as provided in this Agreement, the Subcontractor may, without prejudice to any other available remedies, upon seven additional days' written notice to the Contractor, stop the Work of this Subcontract until payment of the amount owing has been received. The Subcontract Sum shall, by appropriate adjustment, be increased by the amount of the Subcontractor's reasonable costs of demobilization, delay and remobilization.
ARTICLE 5 CHANGES IN THE WORK

5.1 The Owner may make changes in the Work by issuing Modifications to the Prime Contract. Upon receipt of such a Modification issues subsequent to the execution of the Subcontract Agreement, the Contractor shall promptly notify the Subcontractor of the Modification. Unless otherwise directed by the Contractor, the Subcontractor shall not thereafter order materials or perform Work which would be inconsistent with the changes made by the Modifications to the Prime Contract.

5.2 The Subcontractor may be ordered in writing by the Contractor, without invalidating this Subcontract, to make changes in the Work within the general scope of this Subcontract consisting of additions, deletions or other revisions, including those required by Modifications to the Prime Contract issued subsequent to the execution of this Agreement, the Subcontract Sum and the Subcontract Time being adjusted accordingly. The Subcontractor, prior to the commencement of such changed or revised Work, shall submit promptly to the Contractor written copies of a claim for adjustment to the Subcontract Sum and Subcontract Time for such revised Work in a manner consistent with requirements of the Subcontract Documents.

5.3 The Subcontractor shall make all claims promptly to the Contractor for additional cost, extensions of time and damages for delays or other causes in accordance with the Subcontract Documents. A claim which will affect or become part of a claim which the contractor is required to make under the Prime Contract within a specified time period or in a specified manner shall be made in sufficient time to permit the Contractor to satisfy the requirements of the Prime Contract. Such claims shall be received by the Contractor no less than two working days preceding the time by which the Contractor's claim must be made. Failure of the Subcontractor to make such a timely claim shall bind the Subcontractor to the same consequences as those to which the Contractor is bound.

ARTICLE 6 MEDIATION AND ARBITRATION

6.1 MEDIATION

6.1.1 Any claim arising out of or related to this Subcontract, except claims as otherwise provided in Subparagraph 4.1.5 and except those waived in this Subcontract, shall be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.

6.1.2 The parties shall endeavor to resolve their claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect. Request for mediation shall be filed in writing with the other party to this Subcontract and the American Arbitration Association. The request may be made concurrently with the filing of a demand for arbitration but, in such event, mediation shall proceed in advance of arbitration or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

6.1.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

6.2 ARBITRATION

6.2.1 Any claim arising out of or related to this Subcontract, except claims as otherwise provided in Subparagraph 4.1.5 and except those waived in this Subcontract, shall be subject to arbitration. Prior to arbitration, the parties shall endeavor to resolve disputes by mediation in accordance with the provisions of Paragraph 6.1.
6.2.2 Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect. Demand for arbitration shall be filed in writing with the other party to this Subcontract and with the American Arbitration Association, and a copy shall be filed with the Architect.

6.2.3 A demand for arbitration shall be made within the time limits specified in the conditions of the Prime Contract as applicable, and in other cases within a reasonable time after the claim has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such claim would be barred by the applicable statute of limitations.

6.2.4 Limitation on Consolidation or Joinder. Except by written consent of the person or entity sought to be joined, no arbitration arising out of or relating to the Subcontract shall include, by consolidation or joinder or in any other manner, any person or entity not a party to the Subcontract under which such arbitration arises, unless it is shown at the time the demand for arbitration is filed that (1) such person or entity is substantially involved in a common question of fact or law, (2) the presence of such person or entity is required if complete relief is to be accorded in the arbitration, (3) the interest or responsibility of such person or entity in the matter is not insubstantial, and (4) such person or entity is not the Architect, the Architect's employee, the Architect's consultant, or an employee or agent of any of them. This agreement to arbitrate and any other written agreement to arbitrate with an additional person or persons referred to herein shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

6.2.5 Claims and Timely Assertion of Claims. The party filing a notice of demand for arbitration must assert in the demand all claims then known to that party on which arbitration is permitted to be demanded.

6.2.6 Judgment on Final Award. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

ARTICLE 7 TERMINATION, SUSPENSION OR ASSIGNMENT OF THE SUBCONTRACT

7.1 TERMINATION BY THE SUBCONTRACTOR

7.1.1 The Subcontractor may terminate the Subcontract for the same reasons and under the same circumstances and procedures with respect to the Contractor as the Contractor may terminate with respect to the Owner under the Prime Contract, or for nonpayment of amounts due under this Subcontract for 60 days or longer. In the event of such termination by the Subcontractor for any reason which is not the fault of the Subcontractor, Sub-subcontractors or their agents or employees or other persons performing portions of the Work under contract with the Subcontractor, the Subcontractor shall be entitled to recover from the Contractor payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages.

7.2 TERMINATION BY THE CONTRACTOR

7.2.1 If the Subcontractor persistently or repeatedly fails or neglects to carry out the Work in accordance with the Subcontract Documents or otherwise to perform in accordance with this Subcontract and fails within three days after receipt of written notice to commence and continue correction of such default or neglect with diligence and promptness, the Contractor may, after seven days following receipt by the Subcontractor of an additional written notice and without prejudice to any other remedy the Contractor may have, terminate the Subcontract and finish the Subcontractor's Work by whatever method the Contractor may deem expedient.
unpaid balance of the Subcontract Sum exceeds the expense of finishing the Subcontractor's Work and other damages incurred by the Contractor and not expressly waived, such excess shall be paid to the Subcontractor. If such expense and damages exceed such unpaid balance, the Subcontractor shall pay the difference to the Contractor.

7.2.2 If the Owner terminates the Contract for the Owner's convenience, the Contractor shall deliver written notice to the Subcontractor.

7.2.3 Upon receipt of written notice of termination, the Subcontractor shall:
   .1 cease operations as directed by the Contractor in the notice;
   .2 take actions necessary, or that the Contractor may direct, for the protection and preservation of the Work; and
   .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing Sub-subcontracts and purchase orders and enter into no further Sub-subcontracts and purchase orders.

7.2.4 In case of such termination for the Owner's convenience, the Subcontractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

7.3 SUSPENSION BY THE CONTRACTOR FOR CONVENIENCE

7.3.1 The Contractor may, without cause, order the Subcontractor in writing to suspend, delay or interrupt the Work of this Subcontract in whole or in part for such period of time as the Contractor may determine. In the event of suspension ordered by the Contractor, the Subcontractor shall be entitled to an equitable adjustment of the Subcontract Time and Subcontract Sum.

7.3.2 An adjustment shall be made for increases in the Subcontract Time and Subcontract Sum, including profit on the increased cost of performance, caused by suspension, delay or interruption. No adjustment shall be made to the extent:
   .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Subcontractor is responsible;
   .2 that an equitable adjustment is made or denied under another provision of this Subcontract.

7.4 ASSIGNMENT OF THE SUBCONTRACT

7.4.1 In the event of termination of the Prime Contract by the Owner, the Contractor may assign this Subcontract to the Owner, with the Owner's agreement, subject to the provisions of the Prime Contract and to the prior rights of the surety, if any, obligated under bonds relating to the Prime Contract. In such event, the Owner shall assume the Contractor's rights and obligations under the Subcontract Documents. If the Work of the Prime Contract has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted.

7.4.2 The Subcontractor shall not assign the Work of this Subcontract without the written consent of the Contractor, nor subcontract the whole of this Subcontract without the written consent of the Contractor, nor further subcontract portions of this Subcontract without written notification to the Contractor when such notification is requested by the Contractor.
ARTICLE 8 THE WORK OF THIS SUBCONTRACT

8.1 The Subcontractor shall execute the following portion of the Work described in the Subcontract Documents, including all labor, materials, equipment, services and other items required to complete such portion of the Work, except to the extent specifically indicated in the Subcontract Documents to be the responsibility of others.

(Insert a precise description of the Work of this Subcontract, referring where appropriate to numbers of Drawings, sections of Specifications and pages of Addenda, Modifications and accepted Alternates.)

ARTICLE 9 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

9.1 The Subcontractor’s date of commencement is the date from which the Contract Time of Paragraph 9.3 is measured; it shall be the date of this Agreement, as first written above, unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Contractor. Subcontractor agrees to commence and to complete its work required by this Subcontract as required by job progress or within the following time limits:

As directed by Martel Construction, Inc., from time to time.

(Insert the date of commencement, if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

9.2 Unless the date of commencement is established by a notice to proceed issued by the Contractor, or the contractor has commenced visible Work at the site under the Prime Contract, the Subcontractor shall notify the contractor in writing not less than five days before commencing the Subcontractor’s Work to permit the timely filing of mortgages, mechanic’s liens and other security interests.

9.3 The Work of this Subcontract shall be substantially completed not later than

(Insert the calendar date or number of calendar days after the Subcontractor’s date of commencement. Also insert any requirements for earlier Substantial Completion of certain portions of the Subcontractor’s Work, if not stated elsewhere in the Subcontract documents.)

, subject to adjustments of this Subcontract Time as provided in the Subcontract Documents.

(Insert provisions, if any, for liquidated damages relating to failure to complete on time.)

None

9.4 With respect to the obligations of both the Contractor and the Subcontractor, time is of the essence of this Subcontract.

9.5 No extension of time will be valid without the contractor's written consent after claim made by the Subcontractor in accordance with Paragraph 5.3.
ARTICLE 10 SUBCONTRACT SUM

10.1 The Contractor shall pay the Subcontractor in current funds for performance of the Subcontract the Subcontract Sum of:

words dollars

( numbers ), subject to additions and deductions as provided in the Subcontract Documents.

10.2 The Subcontract Sum is based upon the following alternates, if any, which are described in the Subcontract Documents and have been accepted by the Owner and the Contractor:

(Insert the numbers or other identification of accepted alternates.)

There are no alternates

10.3 Unit prices, if any, are as follows:

There are no unit costs

ARTICLE 11 PROGRESS PAYMENTS

11.1 Based upon applications for payment submitted to the Contractor by the Subcontractor, corresponding to applications for payment submitted by the Contractor to the Architect, and certificates for payment issued by the Architect, the Contractor shall make progress payments on account of the Subcontract Sum to the Subcontractor as provided below and elsewhere in the Subcontract Documents. Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor and Subcontractor for Work properly performed by their contractors and suppliers shall be held by the Contractor and Subcontractor for those contractors or suppliers who performed Work of furnished materials, or both, under contract with the Contractor or Subcontractor for which payment was made to the Contractor by the Owner or to the Subcontractor by the Contractor, as applicable. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the contractor or Subcontractor, shall create any fiduciary liability or tort liability on the part of the Contractor of Subcontractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the contractor or Subcontractor for breach of the requirements of this provision.

11.2 The period covered by each application for payment shall be one calendar month ending on the last day of the month, or as follows: Retainage will be withheld from each monthly application in the amount of 5% of the work in place. The first progress application will not be processed until Attachments E & H are completed. Progress payments will be made within seven (7) days of receipt of payment from the Owner. It is specifically understood & agreed that the payment to the Subcontract is dependent, as a condition precedent, upon the Contractor receiving contract payments, including retainage payments from the Owner.

11.3 Provided an application for payment is received by the Contractor not later than the 25th day of a month, the Contractor shall include the Subcontractor's Work covered by that application in the next application for payment which the Contractor is entitled to submit to the Architect. The Contractor shall pay the Subcontractor each progress payment within '7' working days after the Contractor receives payment from the Owner. If the Architect does not issue a certificate for payment or the contractor does not receive payment for any cause which is not the fault of the Subcontractor, the Contractor shall pay the Subcontractor, on demand, a progress payment computed as provided in Paragraphs 11.7, 11.8 & 11.9.

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11.4 If an application for payment is received by the Contractor after the application date fixed above, the Subcontractor's Work covered by it shall be included by the contractor in the next application for payment submitted to the Architect.

11.5 Each application for payment shall be based upon the most recent schedule of values submitted by the Subcontractor in accordance with the Subcontract Documents. The schedule of values shall allocate the entire Subcontract Sum among the various portions of the Subcontractor's Work and be prepared in such form and supported by such data to substantiate its accuracy as the Contractor may require. This schedule, unless objected to by the Contractor, shall be used as a basis for reviewing the Subcontractor's applications for payment.

11.6 Applications for payment submitted by the Subcontractor shall indicate the percentage of completion of each portion of the Subcontractor's Work as of the end of the period covered by the application for payment.

11.7 Subject to the provisions of the Subcontract Documents, the amount of each progress payment shall be computed as follows:

11.7.1 Take that portion of the subcontract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Subcontractor's Work by the share of the total Subcontract Sum allocated to that portion of the Subcontractor's Work in the schedule of values, less that percentage actually retained, if any, from payments to the Contractor on account of the Work of the Subcontractor. Pending final determination of cost to the Contractor of changes in the Work which have been properly authorized by the Contractor, amounts not in dispute shall be included to the same extent provided in the Prime Contract, even though the Subcontract Sum has not yet been adjusted;

11.7.2 Add that portion of the Subcontract Sum properly allocable to materials and equipment delivered and suitable stored at the site by the Subcontractor for subsequent incorporation in the Subcontractor's Work or, if approved by the Contractor, suitably stored off the site at a location agreed upon in writing, less the same percentage retainage required by the Prime Contract to be applied to such materials and equipment in the Contractor's application for payment;

11.7.3 Subtract the aggregate of previous payments made by the Contractor; and

11.7.4 Subtract amounts, if any, calculated under Subparagraph 11.7.1 or 11.7.2 which are related to Work of the Subcontractor for which the Architect has withheld or nullified, in whole or in part, a certificate of payment for a cause which is the fault of the Subcontractor.

11.8 Upon the partial or entire disapproval by the Contractor of the Subcontractor's application for payment, the Contractor shall provide written notice to the Subcontractor. When the basis for the disapproval has been remedied, the Subcontractor shall be paid the amounts withheld.

11.9 SUBSTANTIAL COMPLETION

11.9.1 When the Subcontractor's Work or a designated portion thereof is substantially complete and in accordance with the requirements of the Prime contract, the contractor shall, upon application by the Subcontractor, make prompt application for payment for such Work. Within 30 days following issuance by the Architect of the certificate for payment covering such substantially completed Work, the Contractor shall, to the full extent allowed in the Prime Contract, make payment to the Subcontractor, deducting any portion of the funds for the Subcontractor's Work withheld in accordance with the certificate to cover costs of items to be completed or corrected by the Subcontractor. Such payment to the Subcontractor shall be the entire unpaid balance of the Subcontract Sum if a full release of retainage is allowed under the
Prime Contract for the Subcontractor's Work prior to the completion of the entire Project. If the Prime Contract does not allow for a full release of retainage, then such payment shall be an amount which, when added to previous payments to the Subcontractor, will reduce the retainage on the Subcontractor's substantially completed Work to the same percentage of retainage as that on the Contractor's Work covered by the certificate.

ARTICLE 12 FINAL PAYMENT

12.1 Final payment, constituting the entire unpaid balance of the Subcontract Sum, shall be made by the Contractor to the Subcontractor when the Subcontractor's Work is fully performed in accordance with the requirements of the Subcontract Documents, the Architect has issued a certificate for payment covering the Subcontractor's completed Work and the Contractor has received payment from the Owner. If, for any cause which is not the fault of the Subcontractor, a certificate for payment is not issued or the Contractor does not receive timely payment or does not pay the Subcontractor within three working days after receipt of payment from the Owner, final payment to the Subcontractor shall be made upon demand.

No final payments will be made until all closeout items, warranties, as-builts, instructions, etc. are accepted by the Owner and Architect.

It is specifically understood and agreed that the payment to the Subcontract is dependent, as a condition precedent, upon the Contractor receiving contract payments, including retainage payments from the Owner.

12.2 Before issuance of the final payment, the Subcontractor, if required, shall submit evidence satisfactory to the Contractor that all payrolls, bills for materials and equipment, and all known indebtedness connected with the Subcontractor's Work have been satisfied.

ARTICLE 13 INSURANCE AND BONDS

13.1 The Subcontractor shall purchase and maintain insurance of the following types of coverage and limits of liability:
Furnish Certificates of:
   .1 General Liability Insurance including coverage for all vehicles that will be on site as a part of your scope of work. - See Attachment H
   .2 State of Montana Workers Compensation Certificate of Insurance
   .3 Contractors Certificate of Registration - See Attachment B

13.2 Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Subcontractor's Work until date of final payment and termination of any coverage required to be maintained after final payment to the Subcontractor.

13.3 Certificates of insurance acceptable to the Contractor shall be filed with the Contractor prior to commencement of the Subcontractor's Work. These certificates and the insurance policies required by this Article 13 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Contractor. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the final application for payment as required in Article 12. If any information concerning reduction of coverage is not furnished by the insurer, it shall be furnished by the Subcontractor with reasonable promptness according to the Subcontractor's information and belief.
13.4 The Contractor shall furnish to the Subcontractor satisfactory evidence of insurance required of the Contractor under the Prime Contract.

13.5 The Contractor shall promptly, upon request of the Subcontractor, furnish a copy or permit a copy to be made of any bond covering payment of obligations arising under the Subcontract.

13.6 Performance Bond and Payment Bond:

No Bond Required

If a bond is required - the cost of the bond will be reimbursed as an increase to the Subcontract Sum at the cost of the bond.

13.7 PROPERTY INSURANCE

13.7.1 When requested in writing, the contractor shall provide the Subcontractor with copies of the property and equipment policies in effect for the Project. The Contractor shall notify the Subcontractor if the required property insurance policies are not in effect.

13.7.2 If the required property insurance is not in effect for the full value of the Subcontractor's Work, then the Subcontractor shall purchase insurance for the value of the Subcontractor's Work, and the Subcontractor shall be reimbursed for the cost of the insurance by an adjustment in the Subcontract Sum.

13.7.3 Property insurance for the Subcontractor's materials and equipment required for the Subcontractor's Work, stored off site or in transit and not covered by the Project property insurance, shall be paid for through the application for payment process.

13.8 WAIVERS OF SUBROGATION

13.8.1 The Contractor and Subcontractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Owner, the Architect, the Architect's consultants, separate contractors, and any of their subcontractors, sub-subcontractors, agents and employees for damages caused by fire or other causes of loss to the extent covered by property insurance provided under the Prime Contract of other property insurance applicable to the Work, except such rights as they may have to proceeds of such insurance held by the Owner as a fiduciary. The Subcontractor shall require of the Subcontractor's Sub-subcontractors, agents and employees by appropriate agreements, written where legally required for validity, similar waivers in favor of the parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement of otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or no the person or entity had an insurable interest in the property damaged.

ARTICLE 14 TEMPORARY FACILITIES AND WORKING CONDITIONS

14.1 The Contractor shall furnish and make available to the Subcontractor the following temporary facilities, equipment and services; these shall be furnished at no cost to the Subcontractor unless otherwise indicated below:

Refer to Attachment A and the specification.

Storage of material and equipment shall be as directed and approved by the Project Superintendent of the General Contractor.
14.2 Specific working conditions:

(Insert any applicable arrangements concerning working conditions and labor matters for the Project.)

To insure continuous progress of the work and project harmony among all parties, the following measures will be employed:

- In case of pickets, strikes or walk-outs by labor unions, a designated neutral gate will be provided for the use of other crafts.
- Any Subcontractor who fails to perform or staff his work after three days written notice, shall be deemed in default of this contract and subject to replacement and any damages from such action. This is supplemental to paragraph 3.4.1 of the general conditions.
- All work shall be performed subject to the Occupational Safety and Health act (OSHA)
- All Subcontractors will be responsible for their own cleanup. Any subcontractor who fails to keep his work area satisfactorily cleaned up will be notified by the Project Superintendent. If no improvement is made, the General Contractor will assume responsibility for cleanup at the expense to the Subcontractor.

ARTICLE 15 MISCELLANEOUS PROVISIONS

15.1 Where reference is made in this Subcontract to a provision of another Subcontract Document, the reference refers to that provision as amended or supplemented by other provisions of the Subcontract Documents.

15.2 Payments due and unpaid under his Subcontract shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any)

Interest under this paragraph resulting from any delay in the contractors' receipt of payment from the owner will be paid only to the extent that such interest is paid by the owner to the contractor.

(Usury laws and requirements under the Federal Truth in Lending Act, similar state and local consumer credit laws and other regulations at the Owner's, Contractor's and Subcontractor's principal places of business, the location of the Project and elsewhere may affect the validity of this provision. Legal advice should be obtained with respect to deletions or modifications, and also regarding requirements such as written disclosures or waivers)

15.3 Retainage and any reduction thereto is as follows:

Retainage will be 5% of the work in place

15.4 The Contractor and Subcontractor waive claims against each other for consequential damages arising out of or relating to this Subcontract, including without limitation, any consequential damages due to either party's termination in accordance with Article 7.

ARTICLE 16 ENUMERATION OF SUBCONTRACT DOCUMENTS

16.1 The Subcontract Documents, except for Modifications issued after execution of this Subcontract, are enumerated as follows:

16.1.1 This executed 1997 edition of the Standard Form of Agreement Between Contractor and Subcontractor, AIA Document A401-1997;

16.1.2 The Prime Contract, consisting of the Agreement between the Owner and Contractor dated as first entered above and the other Contract Documents enumerated in the Owner-Contractor Agreement;
16.1.3 The following Modifications to the Prime Contract, if any, issued subsequent to the execution of the Owner-Contractor Agreement but prior to the execution of this Agreement:

<table>
<thead>
<tr>
<th>Modification</th>
<th>Date</th>
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16.1.4 Other Documents, if any, forming part of the Subcontract Documents are as follows:

(List any additional documents that are intended to form part of the Subcontract Documents. Requests for proposal and the Subcontractor's bid or proposal should be listed here only if intended to be part of the Subcontract Documents.)

Subcontractor acknowledges the following Attachments:

- Attachment A - Scope of Work
- Attachment B - Contract Certificate of Registration
- Attachment C - Shop Drawings & Submittals
- Attachment D - Construction Schedule
- Attachment F - Safety Requirements
- Attachment F.1 - Clean Up Clause
- Attachment G - Subcontractors Proposal
- Attachment H - Liability Insurance Certificate Requirements
- Attachment I - Immigration Reform and Control Act of 1986
- Attachment L - Lien Releases
- Attachment M - Certified Payroll Requirements
- Attachment N - Contract Forms

This Agreement entered into as of the day and year first written above.

CONTRACTOR (Signature)  
Date: ___________________  
(Printed name and title)

SUBCONTRACTOR (Signature)  
Date: ___________________  
(Printed name and title)

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Specific Contract Inclusions and Exclusions to the Subcontract Agreement between Martel Construction, Inc. and Company

**INCLUSIONS**

Furnish all material and equipment necessary, and perform all labor required for your work as identified below or as additionally shown on/in the contract documents prepared by contract documents include:

- The Drawings - complete, as prepared by XXXX
- The Specifications - Volume 1, Complete as prepared by XXXX
- Addenda - None
- Alternates - None

**NOTE:** All portions of the General Conditions, Supplementary Conditions, Contract Clauses, Special Provisions, General Requirements, etc., included in the contract documents are incorporated into this Subcontract Agreement. Compliance with incorporation into any lower tier subcontracts is the responsibility of the Subcontractor.

Specific reference is made to the following Specifications under Subcontractors scope of work:

**Reference/Title**

- Division 9
- Specification Sections....
- 

**GENERAL SCOPE OF WORK INCLUSIONS:**

- Includes applicable costs of permits, licenses and fees and sales tax for scope of work. (Building Permit by Owner)

- Sleeves, firestopping, flashing and caulking/sealant as applicable to complete work installed under this Subcontract Agreement.

- Provide all seismic protection and/or devices required of subcontractor’s scope of work.

- Includes layout for scope of work (grid lines, corners and benchmarks by Martel).

- Submittals shall be made in accordance with the Contract Documents, General Requirements and applicable Technical Specifications/Contract Drawings. Submittals shall be provided such that approvals are received allowing materials to be delivered to the project site thirty (30) days prior to the commencement of affected work. However, it is prudent to complete the submittal requirements as early as possible to avoid delays in the work resulting from re-submittals, fabrication errors, late material deliveries, etc. Subcontractor must complete submittals in respect of the project's aggressive schedule.
ATTACHMENT A

MSU NAIC Parking Structure

- Submit all required submittals and required shop drawings as required by this Attachment under part "Submittals". Any deviations to contract requirements must be coordinated with all affected parties and costs resulting from the deviation shall be borne by the Subcontractor.

- Subcontractor will submit to Martel, if requested, copies of all relevant publications referenced in the applicable contract specifications as deemed necessary by Martel for proper evaluation of submittals, supplied materials, workmanship, etc.

- Operation and Maintenance data, spare parts lists, spare parts, special tools, inventories of installed properties and training of operation and service personnel must be submitted in accordance with the contract documents and on or before dates determined by Martel. All Owners Training will be pre-scheduled a minimum of thirty (30) days prior, in writing, for formal approval prior to being conducted.

- Provide guarantees (warranties) as required by the contract documents. Guarantees/Warranties shall not commence until the Owner's final acceptance of the project.

- Construction shall be completed in accordance with schedules generated by Martel Construction, Inc. (with Subcontractor participation provided as required by Martel) including updates as directed by Martel. Subcontractor recognizes and agrees to aggressive schedule requirements and shall staff/supply the project as required by project schedules, work progress, and activity milestones. An overall completed project (including administrative items, final punch list and Owner acceptance) date has been established and is scheduled for September 28, 2012.

- Project Management for the duration of the project to administrate subcontractors scope of work timely.

- Site Supervisor for the duration of subcontractor’s work.

- Provide onsite supervision including individual(s) responsible for Quality Management, acceptable to Martel and the Architect/Owner.

- Subcontractor shall designate a knowledgeable, trained safety representative tasked with ensuring compliance and enforcement of safe working practices by its employees.

- Provide capabilities for processing layout drawings, shop drawings, as-builts, submittals, change orders, proposals and other items of an administrative nature.

- Provide off loading, handling, hoisting and suitable storage facilities for all equipment and materials required to complete work performed by subcontractor.

- Furnish and install all new incidental material/equipment, including but not limited to carriers, fasteners and appurtenances necessary to complete work under this Subcontract Agreement.

- Provide layout, including coordinated layout drawings as required, to complete interior and exterior work under this Agreement.
ATTACHMENT A

MSU NAIC Parking Structure

- Construction debris and rubbish generated by work under this Subcontract Agreement shall be removed from the project work area to the jobsite disposal site.

- Protection of subcontractors existing work and restoration of any damages done by work activities under this contract agreement to other trades work.

- Provide all necessary engineering, testing and factory representatives required of the specifications to complete work under this Subcontract Agreement.

- Includes sealing of all penetrations caused by work under this Subcontract Agreement.

- Cutting and core drilling required to complete work of this Subcontract Agreement.

SPECIFIC SCOPE OF WORK INCLUSIONS:

- Per Subcontractors Clarifications – Attachment G

EXCLUSIONS:

- Per Subcontractors Clarifications – Attachment G
ATTACHMENT B

Contractor Certificate of Registration
or
Independent Contractor Exemption

The Department of Labor and Industry Employment Relations Division requires that all Contractors and Subcontractors in the building or construction industry be registered with the State of Montana whether the contractor or subcontractor has employees or not, prior to beginning work on any of our projects.

Licensed plumbers and electricians acting within the scope of their license are exempt.

This requirement will be satisfied by providing Martel Construction, Inc. with a copy of the "Certificate of Contractor Registration" (if you have employees), or a "Certificate of Exemption" (if you have no employees), issued by the Department of Labor.

These requirements also pertain to companies who provide leased employees to Subcontractors. It is the Subcontractors' responsibility to obtain such documentation and present it to Martel Construction, Inc.

For information regarding the Contractor Registration and Certificate of Exemption call Montana Department of Labor and Industry at 406-444-1446 or 406-444-7734 or go to the following web site:

ATTACHMENT C

Shop Drawings & Submittals

All Shop Drawings and Submittals are to be submitted to Martel Construction, Inc. only. Please fill out a separate form for each section submitted. Include section number, manufacturer, model number and color. The subcontractor or material supplier shall note on the Shop Drawings or Submittals any change of materials from the specifications.

**Preliminary Schedule of Values Submittal:** A preliminary Schedule of Values must be submitted as a formal submittal for approval to the Project Manager at least 10 days prior to submitting your first Pay Application Packet. No applications for payment will be reviewed for payment without an approved Schedule of Values. Email subcontractors@martelconstruction.com to request your electronic version of your Schedule of Values.

Submit per Specifications. Any samples shall be submitted per specifications.

**Number of Copies of Submittals**

A. Documents: **Submit one electronic copy in PDF format**; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by the architect.

1. After review, produce duplicates.
2. Retained samples will not be returned to Contractor unless specifically so stated.

Be advised that any Submittal that has received a third rejection is subject to subcontract or purchase order cancellation.

Please send Submittals and Shop Drawings to the following address:

Martel Construction, Inc.
1203 South Church Avenue
Bozeman, Montana 59715

Attn: PM's Name Here
cell
email
ATTACHMENT D

Construction Schedule

Dated…
ATTACHMENT F

SAFETY REQUIREMENTS

The policy of Martel Construction Inc. is to provide and maintain safe working conditions and to follow operating practices that will safeguard all employees. In order to implement this policy the subcontractor will be required to:

1. Provide a safe jobsite and be responsible for the work performance and safety of all employees, personnel, equipment and materials within Subcontractor's or its lower-tier subcontractors' care, custody or control.

2. Adhere to all applicable OSHA/MSHA regulations.


4. Furnish all required safety equipment for its work and ensure all of their employees and lower-tier subcontractors' employees have and wear personal protective equipment in compliance with applicable OSHA/MSHA requirements and Contractors safety rules.

5. Maintain a written Accident Prevention Plan and a jobsite specific safety plan in compliance with applicable OSHA/MSHA regulations. The Plan will address the Subcontractor's role and responsibilities pertaining to safety on the jobsite, training and corrective action and be tailored to safety and health requirements for the work involved. Said plan will be provided to Martel Construction when requested. Subcontractor shall have and enforce disciplinary procedures in the event safety violations are discovered.

6. Attend all safety meetings for the project.

7. Notify the Martel Construction Inc. Superintendent of any unsafe acts or conditions, and all injuries and accidents occurring on the job site.

8. Contractor's supervisor may direct Subcontractors supervisor to remove employees not in compliance with the requirements of this agreement. In the event the Subcontractor fails to promptly correct its safety violation, Contractor may order Subcontractor to stop work until the violation is corrected and may correct the violation and charge all costs of compliance to the Subcontractor.

9. Subcontractor agrees to defend, indemnify and hold Martel Construction harmless from all OSHA/MSHA claims, demands, proceedings, violations, penalties, assessments or fines that arise out of or relate to the Subcontractors failure to comply with any safety-related laws, ordinances, rules, regulations, orders or its obligations here-under. Martel Construction may charge against the sums otherwise owing to Subcontractor the amount of the fine and the fees, costs and expenses incurred by Martel Construction in the defense of the claims citation and/or fine arising from or relating to the Subcontractors above referenced failure. The Subcontractor shall participate in the incremental cost of future fines that are a direct increase due to this Subcontractors OSHA/MSHA violations.
4.4 Clean Up

Add the following clause to Paragraph 4.4

Daily Clean Up.

If daily clean up of materials is not performed by the sub-contractor, the general contractor will do so at a rate of $55 per hour. The sub-contractor will be charged for work performed by the general contractor. Each sub-contractor is responsible for removal and legal on site disposal of all packing, shipping and miscellaneous waste materials associated with and classified as construction debris.

Final Clean-Up

If final clean up of all debris, masking, and over spray is not performed in a timely manner by the sub-contractor, the general contractor will do so at a rate of $55 per hour. The sub-contractor will be charged for work performed by the general contractor.
ATTACHMENT G

Subcontractors Proposal

Per Subcontractors bid proposal dated ...
ATTACHMENT H

Liability Insurance Certificate Requirements

1. “Insurance Requirements”

SUBCONTRACTOR shall purchase and maintain insurance as required to protect MARTEL CONSTRUCTION and the OWNER from claims set forth below which may arise out of or result from operations of the SUBCONTRACTOR under this Agreement, whether such claims arise during performance or subsequent to completion of the operations under the Agreement and whether such operations be by SUBCONTRACTOR or by anyone directly or indirectly employed by SUBCONTRACTOR or by anyone for whose acts the SUBCONTRACTOR may be liable. Insurance shall be purchased from a company licensed to do business in the state (with an "A" rated or better classification) where the Project is located, and shall be written for not less than the limits of liability specified below or as stipulated with the Main Contract, whichever is greater. The types of claims, required coverage and minimum limits of liability are as follows:

a.) Claims under Workers Compensation, disability benefit and other similar employee benefit act; claims for damages because of bodily injury, occupational sickness or disease or death of employees. Minimum insurance coverage shall include:
   i. Workers Compensation Statutory
   ii. Employer's Liability- Each Accident $ 1,000,000
       Disease - Policy Limit $ 1,000,000
       Disease - Each Employee $ 1,000,000

   Workers Compensation coverage must extend to every employee, including all owners and officers of a closely held corporation and/or individuals operating as a sole proprietor or partnership, if they will be working onsite.

b.) COMMERCIAL GENERAL LIABILITY - Claims for damages because of bodily injury or property damage; Insurance shall include:
   i. Premises - Operations
   ii. Products - Completed Operations
   iii. Blanket Contractual - As will cover the provisions of the Agreement
   iv. Broad Form Property Damage
   v. Personal Injury
   vi. No Exclusion for Blanket Explosion, Collapse, and Underground Property Damage
   vii. Operations of Independent Contractors
   viii. No exclusion for injury to subcontractors employees
   ix. No exclusion for residential or multi-family work

Continued on next page
Minimum Policy Limits:
General Aggregate $2,000,000
Products/Completed Operations $2,000,000
Personal Injury $1,000,000
Each Occurrence $1,000,000
Per Project Aggregate Limit Endorsement

SUBCONTRACTOR shall add MARTEL CONSTRUCTION and PROJECT OWNER as Additional Insured(s) for both ongoing and products/completed operations using form CG2010 (11/85) or equivalent. SUBCONTRACTORS' insurance policy shall be considered primary insurance, without recourse to or contribution from any similar insurance carried by MARTEL CONSTRUCTION. The SUBCONTRACTOR shall deliver to MARTEL CONSTRUCTION certificates of insurance evidencing compliance with this insurance provision prior to the commencement of work. SUBCONTRACTOR shall maintain coverage and additional insured status for one year past substantial completion or to the end of the warranty period, whichever is greater.

c.) COMMERCIAL AUTOMOBILE LIABILITY - Claims for damages because of bodily injury or death of any person, or any property damage arising out of the ownership or use of any motor vehicle. Insurance coverage shall include comprehensive Automobile Liability insurance including owned, hired and non-owned vehicles with limits of $1,000,000 or greater, combined single limit for each occurrence for bodily injury and death, or property damage.

With all lines of insurance, the SUBCONTRACTOR is required to provide to MARTEL CONSTRUCTION 30 days written notice if the SUBCONTRACTORS' policy is canceled.
ATTACHMENT I

Immigration Reform and Control Act of 1986

The Subcontractor represents and warrants that it is in compliance with and agrees that it will remain in compliance with the provisions of the Immigration Reform and Control Act of 1986, including but not limited to the provisions of the Act prohibiting hiring and continued employment of unauthorized aliens, requiring verification and record keeping with respect to identity and eligibility for employment, and prohibiting discrimination on the basis of national origin, United States citizenship, or intending citizen status.

The Subcontractor agrees to indemnify and hold Martel Construction, Inc. harmless from all liability, including liability for interest and penalties and including attorney's fees and costs, that Martel incurs as a result of the Subcontractor's failing to comply with any provision of the Immigration Reform and Control Act of 1986.
ATTACHMENT L

Lien Releases

Lien Releases are required to be included in your Pay Application Packet.

Instructions for Filling Out and Submitting Lien Releases

Each and every Application for Payment will require Lien Releases to accompany it as follows:

1. One Martel Lien Release listing Martel Construction, Inc. as your "Customer" to become effective upon release of payment corresponding with the attached Pay Application.

2. One Unconditional Lien Release for each of your second-tier subcontractors and suppliers listed on your approved Schedule of Values. Your subs and suppliers will list you as their "Customer". We recommend that you include a blank copy of the Unconditional Lien Release with your payments to your subs and suppliers. Your subs/suppliers can then sign and return these lien releases to you. Once you receive these they become part of your next Pay Application Packet.

You may request an electronic version of the Lien Releases by emailing subcontractors@martelconstruction.com or call our Bozeman office at 406-586-8585.
MARTEL CONSTRUCTION LIEN WAIVER AND RELEASE
UPON PROGRESS PAYMENT

Project Name: MSU NAIC Parking Structure

Undersigned's Customer: Martel Construction, Inc.

I CERTIFY UNDER PENALTY OF PERJURY UNDER LAWS OF THE STATE OF MONTANA THAT THE ABOVE IS A TRUE AND CORRECT STATEMENT.

Dated: ________________________________

Signature: _________________________________________

Print name: _______________________________________

Title: _____________________________________________

Company

(Company Name)
MARTEL CONSTRUCTION UNCONDITIONAL LIEN WAIVER AND RELEASE UPON PROGRESS PAYMENT

Project Name: MSU NAIC Parking Structure

Project Street Address: 0

Project City, State, Zip: 0

Undersigned's Customer: Company

Total Amount of Invoice(s) or Payment Application(s) Due to Date: _______________________________

Amount of Invoices(s) or Payment Application Due at 0-30 Days: _______________________________

Due at 31-60 Days: _______________________________

Due at 61 Days and Over: _______________________________

Amount Paid to Date on Previous Invoice(s) or Payment Application(s): _______________________________

The undersigned has been paid and has received a progress payment in the above referenced payment amount for all work, materials and equipment the undersigned furnished to customer for the above described property and does hereby waive and release any notice of lien, any private bond right, any claim for payment and any rights under any similar ordinance, rule or statute related to payment rights that the undersigned has on the above described project.

This release covers a progress payment for the work, materials or equipment furnished by the undersigned to the project or to the undersigned's customer which are the subject of the invoice or payment application, but only to the extent of the payment amount or such portion of the payment amount as the undersigned is actually paid, and does not cover any retention withheld, any items, modifications or changes pending approval, disputed items and claims, or items furnished or invoiced after the payment period. Before any recipient of the document relies on it, evidence of payment to the undersigned should be verified. The undersigned warrants that payment has been made and that money received from progress payments was used to promptly pay in full all laborers, subcontractors, materialmen, union dues, and suppliers for all work, materials or equipment that are the subject of this waiver and release.

I CERTIFY UNDER PENALTY OF PERJURY UNDER LAWS OF THE STATE OF MONTANA THAT THE ABOVE IS A TRUE AND CORRECT STATEMENT.

Dated: _______________________________

_________________________________________________
Signature: _________________________________________

_________________________________________________
Print name: _________________________________________

_________________________________________________
Title: _____________________________________________

(Company Name)
ATTACHMENT M

Certified Payroll Requirements

Certified Payroll Reports are required on all Government funded projects

Instructions for Certified Payroll Reports

Starting with your FIRST request for payment on the project, **weekly** Certified Payroll Reports are required. Second Tier Subs are also required to process and turn in Certified Payroll Reports. If you are an Owner and performing the labor yourself, with no employees, please state that on the report and send in a report for each week. Please mail, fax or scan (scan to the email address listed below) **each week** a completed form wh347 Certified Payroll Report to the Martel Construction office. If you are only applying for stored materials or will not be working on site at any time after the first application for payment please state "no work performed" on the report for each week you are not on site. When you are finished working on site at the project please state "**FINAL**" on your last payroll report. In the event you need to go back on site, after you have submitted a "FINAL" report, just turn in the report for the week you are on site and another "FINAL" report when you are done with on site work. Please number your Certified Payroll Reports.

You may request an electronic version of the Certified Payroll Report form by e-mailing Sue Van Dyken svandyken@martelconstruction.com
ATTACHMENT N

Contract Forms

1. Pay Application with Schedule of Values
2. Instructions - Pay Application Packet
3. Identification Form
4. IRS W-9
5. Authorization to Release Information
APPLICATION FOR PAYMENT
This application for payment must be completed and forwarded to Martel Construction no later than the 25th day of each month in order to receive payment when due.

<table>
<thead>
<tr>
<th>To:</th>
<th>Martel Construction, Inc.</th>
<th>Project Name:</th>
<th>MSU NAIC Parking Structure</th>
<th>Application Number:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>From:</td>
<td>Company</td>
<td>Project No:</td>
<td>TBD</td>
<td>Application Date:</td>
<td>1/25/13</td>
</tr>
<tr>
<td></td>
<td>Address</td>
<td>Period From:</td>
<td>1/1/2013</td>
<td>Period To:</td>
<td>1/31/13</td>
</tr>
<tr>
<td></td>
<td>Contract Date:</td>
<td></td>
<td>11/30/2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contract For:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONTRACTOR’S APPLICATION FOR PAYMENT**

1. **ORIGINAL CONTRACT SUM**
   - $2,279,874
   - (value from column C1 of SOV)

2. **Net Change by Change Orders**
   - $7,000
   - (value from column C2 of SOV)

3. **CONTRACT SUM TO DATE**
   - $2,286,874
   - (line 1 plus Line 2)

4. **TOTAL COMPLETED & STORED TO DATE**
   - $154,870
   - (value from column G of SOV)

5. **LESS RETAINAGE (5%)**
   - $7,743
   - (line 4 multiplied by 5%)

6. **TOTAL EARNED LESS RETAINAGE**
   - $147,126
   - (line 6 of LAST Pay Ap)

7. **LESS PREVIOUS CERTIFICATES FOR PAYMENT**
   - $0
   - (value column D minus 5%)

8. **BALANCE DUE BEFORE GROSS RECEIPTS TAX**
   - $147,126
   - (line 8 multiplied by 1%)

9. **LESS 1% CONTRACTOR’S GROSS RECEIPTS TAX**
   - $1,471.26
   - (do not round)

10. **CURRENT PAYMENT DUE**
    - $145,655
    - (line 3 minus line 9)

11. **BALANCE TO FINISH INCLUDING RETAINAGE**
    - $2,139,748
    - (line 3 minus line 4 plus line 5)

Prior to submitting first pay application to Martel Construction…the following documents are required from the subcontractor:

- Signed contract between Martel Construction and subcontractor.
- Approved Schedule of Values.
- Certificate of Worker’s Compensation Insurance.
- Plumbers and Electricians - Copy of current trade license. All others - Montana Certificate of Contractor Registration.
- Certified payroll reports if applicable.

(1) Documents required prior to starting work at job site.
(2) Documents required for every pay period throughout the duration of the project.

Subcontractor
Authorized Signature:__________________________

Title:________________________________________

Date:________________________________________
## SUBCONTRACTOR SCHEDULE OF VALUES

**Subcontractor:** Company  
**Project Name:** MSU NAIC Parking Structure  
**Application No.:** 1  
**Application Date:** 1/25/13  
**Period From:** 1/1/13  
**To:** 1/31/13

In tabulations below, amounts are stated to the nearest dollar.

### General Requirements

<table>
<thead>
<tr>
<th>Description of Work</th>
<th>Scheduled Value</th>
<th>Change Orders</th>
<th>Revised Contract Amount (C1+C2)</th>
<th>Work Completed</th>
<th>Completed and Stored To Date (D + E + F)</th>
<th>Stored Materials (G/C3)</th>
<th>% (G/C3)</th>
<th>Balance to Finish (C3-G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervision</td>
<td>$96,800</td>
<td>$1,000</td>
<td>$96,800</td>
<td>$9,680</td>
<td>$9,680</td>
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<tr>
<td>Mobilization</td>
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<td></td>
<td>$25,000</td>
<td>$2,400</td>
<td>$2,500</td>
<td>$22,500</td>
<td>10%</td>
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<tr>
<td>Indirect Equipment</td>
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<td></td>
<td>$14,000</td>
<td>$1,200</td>
<td>$1,400</td>
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<tr>
<td>Hoisting</td>
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<td>$75,000</td>
<td>$7,000</td>
<td>$7,500</td>
<td>$67,500</td>
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<td>Layout</td>
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<td>$2,000</td>
<td>$41,000</td>
<td>$4,100</td>
<td>$4,100</td>
<td>$36,900</td>
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<tr>
<td>Site Cleanup</td>
<td>$40,899</td>
<td></td>
<td>$40,899</td>
<td>$4,090</td>
<td>$4,090</td>
<td>$36,809</td>
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<tr>
<td>Weather Protection</td>
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<td>$105,000</td>
<td>$10,500</td>
<td>$10,500</td>
<td>$94,500</td>
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<tr>
<td>Bond</td>
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<td>$23,975</td>
<td>$23,975</td>
<td>$23,975</td>
<td>$0</td>
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<tr>
<td>Construction OH &amp; Profit</td>
<td>$50,000</td>
<td></td>
<td>$50,000</td>
<td>$0</td>
<td>$0</td>
<td>$50,000</td>
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### Project Closeout

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<th>Description of Work</th>
<th>Scheduled Value</th>
<th>Change Orders</th>
<th>Revised Contract Amount (C1+C2)</th>
<th>Work Completed</th>
<th>Completed and Stored To Date (D + E + F)</th>
<th>Stored Materials (G/C3)</th>
<th>% (G/C3)</th>
<th>Balance to Finish (C3-G)</th>
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<tbody>
<tr>
<td>As-Builts: Drawings</td>
<td>$8,000</td>
<td></td>
<td>$8,000</td>
<td>$0</td>
<td>$0</td>
<td>$8,000</td>
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<tr>
<td>O&amp;M Manuals</td>
<td>$8,000</td>
<td></td>
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<td>$0</td>
<td>$0</td>
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<td>Project Punchlist</td>
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<tr>
<td>Demobilization</td>
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</table>

### Labor & Equipment

#### Footings

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<tr>
<th>Description of Work</th>
<th>Scheduled Value</th>
<th>Change Orders</th>
<th>Revised Contract Amount (C1+C2)</th>
<th>Work Completed</th>
<th>Completed and Stored To Date (D + E + F)</th>
<th>Stored Materials (G/C3)</th>
<th>% (G/C3)</th>
<th>Balance to Finish (C3-G)</th>
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<tbody>
<tr>
<td>Footings - Form Continuous</td>
<td>$215,000</td>
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<td>$215,000</td>
<td>$53,750</td>
<td>$53,750</td>
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<td>Place Continuous Footings</td>
<td>$43,500</td>
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<td>$43,500</td>
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<td>$10,875</td>
<td>$32,625</td>
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<td>Footings - Form Pad</td>
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<td>$75,000</td>
<td>$18,750</td>
<td>$18,750</td>
<td>$56,250</td>
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<td>Place Pad Footings</td>
<td>$31,000</td>
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<td>$31,060</td>
<td>$7,750</td>
<td>$7,750</td>
<td>$23,250</td>
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<tr>
<td>Form Footing Pad - Elevator Shafts</td>
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<td>$0</td>
<td>$0</td>
<td>$22,000</td>
<td>0%</td>
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</tbody>
</table>

#### Walls

<table>
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<tr>
<th>Description of Work</th>
<th>Scheduled Value</th>
<th>Change Orders</th>
<th>Revised Contract Amount (C1+C2)</th>
<th>Work Completed</th>
<th>Completed and Stored To Date (D + E + F)</th>
<th>Stored Materials (G/C3)</th>
<th>% (G/C3)</th>
<th>Balance to Finish (C3-G)</th>
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</thead>
<tbody>
<tr>
<td>Form Materials &amp; Accessories</td>
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<td>Formwork Walls</td>
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<td>$0</td>
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<td>Place Walls - all</td>
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<td>$102,600</td>
<td>$0</td>
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<td>$102,600</td>
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<tr>
<td>Formwork Elevator Shafts</td>
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<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>G</td>
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<tr>
<td>Lien Release Required</td>
<td>Description of Work</td>
<td>Scheduled Value</td>
<td>Change Orders</td>
<td>Revised Contract Amount (C1+C2)</td>
<td>Previous Applications</td>
<td>Work Completed This Application</td>
<td>Completed and Stored To Date (D + E + F)</td>
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INSTRUCTIONS: APPLICATION FOR PAYMENT PACKET

Request your electronic version of our Application for Payment Packet by emailing subcontractors@martelconstruction.com or call the Bozeman office at 406-586-8585.

The Application for Payment and Schedule of Values forms included in your subcontract or PO are not for use. They are Samples/Examples only. **You must complete and submit your Application for Payment Packet by email.**

Instructions for completing your Application for Payment will be included with your electronic version.

**Each and every Pay Application Packet will include:**

1. Application for Payment cover page for the period you are requesting payment.

2. Schedule of Values fully completed. (You must submit a Preliminary Schedule of Values for review at least 10 days prior to submitting your first Pay Application Packet. No applications for payment will be reviewed for payment without an approved Schedule of Values. See Attachment C - Shop Drawings & Submittals for further clarification.)

3. Martel Lien Release for the period you are requesting payment. (See Attachment L for further clarification.)

4. Unconditional Lien Release(s) one from each of your second-tier subcontractors and suppliers listed on your Schedule of Values. (See Attachment L for further clarification.)

5. Certified Payroll (if required by specifications)
IDENTIFICATION FORM

Project: MSU NAIC Parking Structure

Subcontractor:

Company
Address
City, State, Zip

1. If the name and address shown above is incorrect please make appropriate changes.

2. Phone: __________________________ Fax: __________________________

3. E-mail: __________________________

4. Signature: __________________________

   Type/Print Name & Title: __________________________

   Date: __________________________

5. Union Member: Yes ______ No ______

   If Yes:
   Union Name: __________________________
   Union phone: __________________________
   Local Jurisdiction Number: __________________________

PLEASE COMPLETE THE ATTACHED W-9 FORM AND RETURN TO MARTEL CONSTRUCTION

RETURN TO: Martel Construction, Inc.
1203 South Church
Bozeman, MT 59715-5801
Form W-9
(Request for Taxpayer Identification Number and Certification)

Give form to the requester. Do not send to the IRS.

Name (as shown on your income tax return)

Business name, if different from above

Check appropriate box: □ Individual/Sole proprietor □ Corporation □ Partnership
□ Limited liability company. Enter the tax classification (D=disregarded entity, C=corporation, P=partnership) □
□ Exempt payee

Address (number, street, and apt. or suite no.)

City, state, and ZIP code

Requester's name and address (optional)

Part I  Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on Line 1 to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see How to get a TIN on page 3.

Note: If the account is in more than one name, see the chart on page 4 for guidelines on whose number to enter.

Social security number

or

Employer identification number

Part II  Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and
3. I am a U.S. citizen or other U.S. person (defined below).

Certification Instructions: You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest or dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN. See the instructions on page 4.

Signature of U.S. person ▶

Date ▶

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Purpose of Form

A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income.

Note: If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:
• An individual who is a U.S. citizen or U.S. resident alien,
• A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States,
• An estate (other than a foreign estate), or
• A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax on any foreign partners' share of income from such business. Further, in certain cases where a Form W-9 has not been received, a partnership is required to presume that a partner is a foreign person, and pay the withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid withholding on your share of partnership income.

The person who gives Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States is in the following cases:
• The U.S. owner of a disregarded entity and not the entity,
Authorization to Release Information

The undersigned hereby authorize the Unemployment Insurance Division, Department of Labor and Industry to give the prime Contractor, Martel Construction, Inc., information concerning their compliance with the unemployment insurance Program. This authorization covers the duration of the contract for **MSU NAIC Parking Structure**

Please acknowledge this authorization below.

**Business Name and Address**

Company
Address
City, State, Zip

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**Signature**       **Date**

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**Printed Name**       **Title**
SECTION 01006 – BONDS AND CERTIFICATES OF INSURANCE

PART 1 - GENERAL

1.1 PERFORMANCE AND PAYMENT BOND

A. All bonds shall be dual obligee bonds naming Montana State University and Martel Construction, Inc. as additional obligee.

B. All bonding companies must be listed by the U.S. Treasury.

C. All bonding companies must be rated A- or better by Best.

D. All bonding companies must be licensed to do business in Montana.

E. "Performance Bond and Payment Bond", AIA Document A312 - 2010, of the American Institute of Architects, are hereby made a part of the Contract Documents, the same as if bound herein. The Performance and Payment Bond shall be a part of the Contract and shall apply to all Contractors and Subcontractors of the Contract Documents.

1.2 CERTIFICATE OF INSURANCE

A. The Trade Contractor shall purchase and maintain all of the insurance coverage as follows:

1. General Liability: coverage is to be provided under an Occurrence commercial general liability form with limits of $1,000,000 each occurrence; $1,000,000 Personal and Advertising Injury; $2,000,000 General Aggregate and $2,000,000 Products-Completed Operations Aggregate; $500,000 Limited Sudden and Accidental Pollution with additional $10,000 minimum for clean up costs. The policy form shall include the following coverages:

a. Aggregate Limits Per Project/Location (if your limits are not designated on a per project basis, the Umbrella limit requirements will be increased to $2,000,000).

b. Premises/Operations.

c. Blanket Additional insured with primary status for additional insureds. If your policy does not contain a blanket additional insured endorsement, a project specific endorsement naming Martel Construction Inc., and any other designated entities as outlined in the Owner’s general contract may be used.

d. Explosion, Collapse, and Underground.

e. Broad Form Property Damage including Completed Operations.

f. Contractual Liability.

g. Blanket Waiver of Subrogation.

h. Limited sudden and accidental pollution – this coverage should provide coverage for property damage and personal injury that arise out of pollutants brought onto the job site by you and/or your sub-subcontractors.

i. Contingent liability for operations performed on your behalf by sub-subcontractors.

2. Automobile Liability Insurance: The Automobile Insurance shall be written on a standard Business Automobile policy with a Combined Single Limit of $1,000,000 for bodily injury and property damage. Coverage must be provided for all owner, non-owned, and hired automobiles. The policy form shall include the following coverages:

a. Broadened Pollution Liability.
3. Worker’s Compensation: as a Trade Contractor, you are obligated to provide Workers’ Compensation and Employer’s Liability insurance as required by applicable state law for all employees engaged in work at the project site pursuant to this contract. The minimum limit is $500,000.00. If at any point during the contract any portion of the work is sublet, you will require the sub-subcontractor to certify the same insurance.

4. Contractors Equipment: As a Trade Contractor, it is assumed you will have the opportunity to borrow Martel’s owned, leased, or rental equipment. You shall provide insurance which will respond to damage to any of this equipment while it is under your care. The insurance should contain coverage for a minimum of $10,000 of pollution clean-up costs and shall also respond to any additional rental costs. In addition, a waiver of subrogation in favor of Martel Construction, Inc. and any Owner required entities shall be included on all your equipment policies for your owned, leased, or rented equipment.

5. Umbrella Liability Insurance: The Umbrella policy shall be written with a limit of liability of $1,000,000 per occurrence and $1,000,000 aggregate. The policy should provide excess coverage on a Drop Down basis over the General Liability, the Automobile Liability and the Employer’s Liability.

B. General Conditions:

1. All policies shall be endorsed to provide Martel Construction, Inc. with 30 days notice of cancellation or reductions in coverage.

2. All coverages shall be written with insurance carriers which have an A.M. Best’s Rating of A- or better or with carriers approved by Martel Construction, Inc.

3. The insurance required by Martel Construction, Inc. in no way represents protection from all the exposures to you. You may need to purchase other insurance coverages, at your own expense, to further protect yourself.

4. Failure to secure insurance as required in this contract will not relieve you for responsibility for any claim.

5. No additional payments will be made to you for the purchase of any of the required insurance coverages. It is assumed all costs are included within your subcontract price.

6. You shall require all lower tier subcontractors to certify insurance which meets all outlined insurance requirements in the contract documents.

C. Certificates of Insurance:

1. Prior to the start of any work, a Certificate of Insurance, as shown in Exhibit 1, shall be provided by the Subcontractor evidencing all of the required coverages and limits as outlined above. The certificate holder is Martel Construction, Inc. and Montana State University shall be named as additional insured.

PART 2 - PRODUCTS (not applicable).

PART 3 - EXECUTION (not applicable).

END OF SECTION 01006
SECTION 01250 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue through General Contractor supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect via the General Contractor are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include an updated Construction Manager's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

1.5 CHANGE ORDER PROCEDURES


1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Construction Change Directives will only be used in situations where the normal procedure of obtaining preliminary Proposal Request pricing is not a possibility due to urgent demands from the construction process.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01250
SECTION 01291 - TRADE CONTRACTOR APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements governing the Sub Contractor's and Suppliers Applications for Payment.

1. Coordinate the Schedule of Values and Applications for Payment with the General Contractor's Construction Billing System and Cycle to the Owner. Prior to the first Application for Payment, submit a schedule of values for approval.

B. The Terms and Conditions for Payment are as follows:

Subcontract / Supplier shall submit application for payment to Martel Construction on or before the 25th of each month. Payment to be made within 7 days of receipt of payment from the Owner. Payments from the Owner are no later than the 20th day of the month.

Trade contractors shall have a retainage of 5% withheld from each progress payment. Retainage will be released within 35 days from Owner’s Final acceptance of the subcontractors work.

1.3 SCHEDULE OF VALUES

A. Coordinate preparation of the Schedule of Values with Martel Construction, Inc.

1. Correlate line items in the Schedule of Values with other required administrative schedules and forms which may include:

Contractor's construction schedule.
Application for Payment form.
List of subcontractors.
Schedule of allowances.
Schedule of alternates.
List of products.
List of principal suppliers and fabricators.
Schedule of submittals.

2. Submit the Schedule of Values to Martel Construction at the earliest feasible date, but in no case later than 15 days after the Notice to Proceed.

B. Sub-Schedules: Where the Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

C. Format and Content: Use the CSI format as a guide to establish the format for the Schedule of Values.
1. Identification: Include the following Project identification on the Schedule of Values:

   Project name and location.
   Name of the Architect.
   Martel Construction Project number.
   Contractor's name and address.
   Date of submittal.

2. Arrange the Schedule of Values in a tabular form. Use the AIA 702 & 703 Format.

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Break principal subcontract amounts down into several line items.

4. Round amounts off to the nearest whole dollar; the total shall equal the Contract Sum.

5. For each part of the Work where an Application for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

D. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to the extent that such items will be listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete including its total cost and proportionate share of general overhead and profit margin.

   1. As an option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in the Schedule of Values or distributed as general overhead expense.

E. Schedule Updating: Update the Schedule of Values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Do not revise the Schedule of Values prior to an approved change.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.

   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.
   2. Retainage of 5% will be held on all Trade Contractors.

B. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work covered by each Application or Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G 702 and Continuation Sheets G 703 for Application for Payment.

D. Application Preparation: Complete every entry on the form, including execution by person authorized to sign legal documents. Incomplete applications will be returned without action.
1. Entries shall match data on the Original Schedule of Values.

2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

E. Transmittal: Submit 1 executed copy of each Application for Payment to Martel Construction by means ensuring receipt within 24 hours; one copy shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to Martel Construction.

F. Waivers of Mechanics Lien: With each Application for Payment submit waivers of mechanics liens from Trade Contractors or sub-Trade Contractors and suppliers for the construction period covered by the previous application.

1. Submit partial waivers on each item for the amount requested, prior to deduction for retainage, on each item.

2. When an application shows completion, submit final or full waivers.

3. The Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Waiver Forms: Submit waivers of lien on forms, and executed in a manner acceptable to Martel Construction.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:

List of subcontractors.
List of principal suppliers and fabricators.
Schedule of Values.

Submittal Schedule (preliminary if not final).
List of Contractor's staff assignments.
List of Contractor's principal consultants.
Copies of building permits.
Copies of authorizations and licenses from governing authorities for performance of the Work.
Certificates of insurance and insurance policies.

Performance and payment bonds (if required).

H. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment; this application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

Administrative actions and submittals that shall proceed or coincide with this application include:

Occupancy permits and similar approvals.
Warranties (guarantees) and maintenance agreements.
Test/adjust/balance records.
Maintenance instructions.
Meter readings.
Start-up performance reports.
Change-over information related to Owner's occupancy, use, operation and maintenance.
Final cleaning.
Application for reduction of retainage, and consent of surety.
Advice on shifting insurance coverages.
Final progress photographs.
List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

I.

Final Payment Application: Administrative actions and submittals which must precede or coincide with submittal of the final payment Application for Payment include the following:

Completion of Project closeout requirements.
Completion of items specified for completion after Substantial Completion.
Assurance that unsettled claims will be settled.
Assurance that Work not complete and accepted will be completed without undue delay.
Transmittal of required Project construction records to Owner.
Certified property survey.
Proof that taxes, fees and similar obligations have been paid.
Removal of temporary facilities and services.
Removal of surplus materials, rubbish and similar elements.
Change of door locks to Owner's access.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION (Not Applicable).

END OF SECTION 01291
SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:
   1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations. Coordinate with owner to connect to system to be provided by the owner.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts and top rail.

B. Portable Chain-Link Fencing: galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

F. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Install electric power service underground unless otherwise indicated.
   2. Connect temporary service to Owner's existing power source, as directed by Owner.

J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.
   1. Provide additional telephone lines for the following:
   2. At each telephone, post a list of important telephone numbers.
   3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide construction for temporary offices, shops, and sheds located within construction area that is noncombustible according to ASTM E 136. Comply with NFPA 241.
   2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
   1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
   1. Identification Signs: Provide Project identification signs as indicated on Drawings.
   2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      a. Provide temporary, directional signs for construction personnel and visitors.
   3. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.


K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
   1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings, or authorities having jurisdiction, whichever is more stringent.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
   1. Extent of Fence: As indicated on Drawings.
   2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.
   1. Prohibit smoking in construction areas.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor’s Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Keep interior spaces reasonably clean and protected from water damage.
2. Discard or replace water-damaged and wet material.
3. Discard, replace, or clean stored or installed material that begins to grow mold.
4. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000
SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:
   1. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until installation.
   4. Protect items from damage during transport and storage.
   5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
B. Salvaged Items for sale not permitted.

C. Salvaged Items for Owner's Use:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning, identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area designated by Owner.
   5. Protect items from damage during transport and storage.

1.4 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.

C. Procedures in "Procedures" Paragraph below describe the "source-separated" method for handling recyclable waste. If space at Project site is limited, consider revising below to allow "co-mingled" method, which takes less space because it permits all recyclable waste to be placed in a single container that is separated later at the recycling facility.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   
   a. Inspect containers and bins for contamination and remove contaminated materials if found.
   
   2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   
   3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
   
   4. Store components off the ground and protect from the weather.
   
   5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

1.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   
   
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site.
      For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

1.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419
1. ARTICLE 1 – GENERAL PROVISIONS

1.1. BASIC DEFINITIONS

1.1.1. CONTRACT DOCUMENTS The Contract Documents consist of the Contract between Owner and Contractor (hereinafter the “Contract”), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Contract and Modifications issued after execution of the Contract. A Modification is: (1) a written amendment to the Contract signed by both parties; (2) a Change Order; (3) a Construction Change Directive; or, (4) a written order for a minor change in the Work issued by the Architect/Engineer. The Contract Documents shall include the bidding documents and any alterations made thereto by addenda. In the event of a conflict, discrepancy, contradiction, or inconsistency within the Contract Documents and for the resolution of same, the following order of hierarchy and control shall apply and prevail:

1.1.1.1. Contract; 2) Addenda; 3) Pre-Construction Services Conditions; 4) Supplementary General Conditions, if any; 5) General Conditions of the Contract for Construction; 6) Specifications; 7) Drawings; 8) GC/CM Request for Proposals; 9) Sample Forms.

1.2. If a conflict, discrepancy, contradiction, or inconsistency occurs within or between the Specifications and the Drawings, resolution shall be controlled by the following:

1.2.1.1. As between figures, dimensions, or numbers given on drawings and any scaled measurements, the figures, dimensions, or numbers shall govern;

1.2.1.2. As between large scale drawings and small scale drawings, the larger scale drawings shall govern;

1.2.1.3. As between the technical specifications and drawings; the technical specifications shall govern.

1.2.1.4. Shop Drawings and Submittals: Shop drawings and other submittals from the Contractor, subcontractors, or suppliers do not constitute a part of the Contract Documents.

1.3. The Contractor acknowledges, understands and agrees that the Contract Documents cannot be changed except as provided herein by the terms of the Contract. No act(s), action(s), omission(s), or course of dealing(s) by the Owner or Architect/Engineer with the Contractor shall alter the requirements of the Contract Documents and that alteration can be accomplished only through a written Modification process defined herein.

1.3.1. THE DRAWINGS The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, intent, location, and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

1.3.2. THE SPECIFICATIONS The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

1.3.3. THE CONTRACT The entire Contract for Construction is formed by the Contract Documents. The Contract represents the entire, complete, and integrated agreement between the Owner and Contract hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a
contractual relationship of any kind between: (1) the Architect/Engineer and Contractor; (2) the Owner and any Subcontractor, Sub-subcontractor, or Supplier; (3) the Owner and Architect/Engineer; or, (4) between any persons or entities other than the Owner and Contractor. However, the Architect/Engineer shall at all times be permitted and entitled to performance and enforcement of its obligations under the Contract intended to facilitate performance of the Architect/Engineer's duties.

1.3.4. **THE WORK** The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to completely fulfill the Contract and the Contractor's obligations. The Work may constitute the whole or a part of the Project and does not include any Pre-Construction Services.

1.3.5. **THE PROJECT** The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.

1.3.6. **TIME** Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day of a duration or time period shall be determined as the day following the current day of any event or notice starting a specified duration. All durations in the Contract Documents are calendar days unless specifically stated otherwise.

1.4. **CORRELATION, INTER-RELATIONSHIP, AND INTENT OF THE CONTRACT DOCUMENTS**

1.4.1. The intent of the Contract Documents is to include all items and all effort necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and inter-related, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

1.4.2. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. It is the Contractor's responsibility to control the Work under the Contract.

1.4.3. Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

1.5. **CAPITALIZATION**

1.5.1. Terms capitalized in these General Conditions include those which are: (1) specifically defined; and, (2) the titles of numbered articles and identified references to Paragraphs, Subparagraphs and Clauses in the document.

1.6. **INTERPRETATION**

1.6.1. In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

1.7. **EXECUTION OF THE CONTRACT AND CONTRACT DOCUMENTS**

1.7.1. The Contract shall be signed by the Owner and Contractor. Execution of the Contract by the Contractor constitutes the complete and irrevocable binding of the Contractor and his Surety to the Owner for complete performance of the Work and fulfillment of all obligations. By execution of the Contract, the Contractor acknowledges that it has reviewed and familiarized itself with all aspects of the Contract Documents and agrees to be bound by the terms and conditions contained therein.

1.7.2. Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.
1.7.3. The Contractor acknowledges that it has taken all reasonable actions necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to: (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, gas, electric power, phone service, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation, topography, and conditions of the ground; and, (5) the character of equipment and facilities needed for performance of the Work. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory geotechnical work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the action described and acknowledged in this paragraph will not relieve the Contractor from responsibility for properly ascertaining and estimating the difficulty and cost of successfully performing the Work or for proceeding to successfully perform the Work without additional expense to the Owner.

1.7.4. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Owner, nor does the Owner assume responsibility for any understanding reached or representation made by any of its officers, agents, or employees concerning conditions which can affect the Work unless that understanding or representation is expressly stated in the Contract Documents.

1.7.4.1. Performance of any portion of the Work, beyond that required for complying with the specifications and all other requirements of the Contract, shall be deemed to be for the convenience of the Contractor and shall be at the Contractor's sole expense.

1.7.4.2. There shall be no increase in the contract price or time allowed for performance which is for the convenience of the Contractor.

1.8. OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER INSTRUMENTS OF SERVICE

1.8.1. The Drawings, Specifications and other documents, including those in electronic form, prepared by the Architect/Engineer and the Architect/Engineer's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect/Engineer or the Architect/Engineer's consultants. Unless otherwise indicated, the Architect/Engineer and the Architect/Engineer's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights except as defined in the Owner's Contract with the Architect/Engineer. All copies of Instruments of Service, except the Contractor's record set, shall be returned or suitably accounted for to the Architect/Engineer upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect/Engineer, and the Architect/Engineer's consultants. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect/Engineer's or Architect/Engineer's consultants' copyrights or other reserved rights.

1.8.2. Owner's Disclaimer of Warranty: The Owner has requested the Architect/Engineer prepare the Contract Documents for the Project which are adequate for bidding and constructing the Project. However, the Owner makes no representation, guarantee, or warranty of any nature whatsoever to the Contractor concerning such documents. The Contractor hereby acknowledges and represents that it has not, does not, and will not rely upon any such representation, guarantee, or warranty concerning the Contract Documents as no such representation, guarantee, or warranty have been or are hereby made.
2. ARTICLE 2 – THE OWNER

2.1. THE STATE OF MONTANA

2.1.1. The Owner is the State of Montana and is the sole entity to be identified as Owner in the Contract and as referred to throughout the Contract Documents as if singular in number.

2.1.2. Except as otherwise provided in Subparagraph 4.2.1, the Architect/Engineer does not have authority to bind the Owner. The observations and participations of the Owner or its authorized representative do not alleviate any responsibility on the part of the Contractor. The Owner reserves the right to observe the work and make comment. Any action or lack of action by the Owner shall not be construed as approval of the Contractor's performance.

2.1.3. The Owner reserves the right to require the Contractor, all sub-contractors and material suppliers to provide lien releases at any time. The Owner reserves the right to withhold progress payments until such lien releases are received for all work for which prior progress payments have been made. Upon the Owner's demand for lien releases (either verbally or written), the Contractor, all sub-contractors and material suppliers shall provide such releases with every subsequent application for payment through Final Acceptance of the Project.

2.1.4. Except for permits and fees, including those required under Subparagraph 3.7.1, which are the responsibility of the Contractor under the Contract Documents, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

2.1.5. Information or services required of the Owner by the Contract Documents shall be furnished by the Owner with reasonable promptness. Any other information or services relevant to the Contractor's performance of the Work under the Owner's control shall be furnished by the Owner after receipt from the Contractor of a written request for such information or services.

2.1.6. Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Specifications as are reasonably necessary for execution of the Work.

2.2. OWNER'S RIGHT TO STOP WORK

2.2.1. If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Paragraph 12.2 or persistently fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated. However, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 6.1.3. The issuance of a stop work order by the Owner shall not give rise to a claim by the Contractor or any subcontractor for additional cost, time, or other adjustment.

2.3. OWNER'S RIGHT TO CARRY OUT THE WORK

2.3.1. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a three-day period. If the Contractor within such three-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and increased costs, and compensation for the Architect/Engineer's additional services made necessary by such default, neglect, or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

2.4. OWNER'S RIGHT TO PERSONNEL
2.4.1. The Owner reserves the right to have the Contractor and/or subcontractors remove person(s) and/or personnel from any and all work on the project with cause but without cost to the Owner. Such requests from the Owner may be made verbally or in writing and may be done directly with the Contractor or indirectly through the Architect/Engineer. Cause may be, but not limited to, any of the following: incompetence, poor workmanship, poor scheduling abilities, poor coordination, disruption to the facility or others, poor management, causes delay or delays, disruption of the Project, will not strictly adhere to facility procedures and Project requirements either knowingly or unknowingly, insubordination, drug/alcohol use, possession of contraband, belligerent acts or actions, etc. The Contractor shall provide replacement person(s) and/or personnel acceptable to the Owner at no cost to the Owner.

2.4.2. Any issue or circumstance relating to or resulting out of this clause shall not be construed or interpreted to be interference with or impacting upon the Contractor’s responsibilities and liabilities under the Contract Documents.

2.4.3. Person(s) and/or personnel who do not perform in accordance with the Contract Documents, shall be deemed to have provided the Owner with cause to have such persons removed from any and all involvement in the Work.

2.4.4. The Contractor agrees to indemnify and hold harmless the Owner from any and all causes of action, demands, claims, damages, awards, attorneys’ fees, and other costs brought against the Owner and/or Architect/Engineer by any and all person(s) or personnel as a result of actions under this clause.

3. ARTICLE 3 – THE CONTRACTOR

3.1. GENERAL

3.1.1. The Contractor is the person or entity identified as such in the Contract and is referred to throughout the Contract Documents as if singular in number. The term “Contractor” means the Contractor or the Contractor’s authorized representative and GC/CM as identified in the Pre-Construction Services Conditions.

3.1.2. Construction Contractor Registration: The Contractor is required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. A bidder must demonstrate that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work. If the prevailing bidder cannot or does not register in time for the Owner to execute the Contract within fifteen (15) days of the date on the notice of award, the Owner may award, at its sole discretion, to the next lowest responsible bidder who meets this requirement. The Owner will not execute a contract for construction nor issue a Notice to Proceed to a Contractor who is not registered per 39-9-401(a) MCA. It is solely the Contractor’s responsibility to ensure that all Subcontractors are registered in accordance with Title 39, Chapter 9, MCA.

3.1.3. The Owner’s engagement of the Contractor is based upon the Contractor’s representations by submission of a bid to the Owner that it:

   3.1.3.1. has the requisite skills, judgment, capacity, expertise, and financial ability to perform the Work;

   3.1.3.2. is experienced in the type of labor and services the Owner is engaging the Contractor to perform;

   3.1.3.3. is authorized, licensed and registered to perform the type of labor and services for which it is being engaged in the State and locality in which the Project is located;

   3.1.3.4. is qualified, willing and able to perform the labor and services for the Project in the manner and scope defined in the Contract Documents; and,

   3.1.3.5. has the expertise and ability to provide labor and services that will meet the Owner’s objectives, intent and requirements, and will comply with the requirements of all governmental, public, and quasi-public authorities and agencies having or asserting jurisdiction over the Project.

3.1.4. The Contractor shall perform the Work in accordance with the Contract Documents.
3.1.5. The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect/Engineer in the Architect/Engineer's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.1.6. Quality Control (i.e. ensuring compliance with the Contract Documents) and Quality Assurance (i.e. confirming compliance with the Contract Documents) are the responsibility of the Contractor. Testing, observations, and/or inspections performed or provided by the Owner are solely for the Owner's own purposes and are for the benefit of the Owner. The Owner is not liable or responsible in any form or fashion to the Contractor regarding quality assurance or extent of such assurances. The Contractor shall not, under any circumstances, rely upon the Owner's testing or inspections as a substitute or in lieu of its own Quality Control or Assurance programs.

3.2. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.1. Since the Contract Documents are complementary and inter-related, before starting each portion of the Work, the Contractor shall carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions affecting the Work. These obligations are for the purpose of facilitating construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents. However, any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Architect/Engineer as a request for information in such form as the Architect/Engineer may require.

3.2.2. Any errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect/Engineer, but it is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

3.2.3. If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect/Engineer in response to the Contractor's notices or requests for information pursuant to Subparagraphs 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Subparagraphs 4.3.4 and 4.3.5. If the Contractor fails to perform the obligations of Subparagraphs 3.2.1 and 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect/Engineer for damages resulting from errors, inconsistencies, or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized such error, inconsistency, omission or difference and failed to report it to the Architect/Engineer.

3.2.4. Except as otherwise expressly provided in this Contract, the Contractor assumes all risks, liabilities, costs, and consequences of performing any effort or work in accordance with any written or oral order (including but not limited to direction, instruction, interpretation, or determination) of a person not authorized in writing by the Owner to issue such an order.

3.2.5. By entering into this Contract, the Contractor acknowledges that it has informed itself fully regarding the requirements of the Drawings and Specifications, the General Conditions, the Supplementary General Conditions, all other documents comprising a part of the Contract Documents and all applicable laws, building codes, ordinances and regulations. Contractor hereby expressly acknowledges, guarantees, and warrants to the Owner that:

3.2.5.1. the Contract Documents are sufficient in detail and scope to enable Contractor to construct the finished project;

3.2.5.2. no additional or further work should be required by Owner at the time of Owner's acceptance of the Work; and,

3.2.5.3. when the Contractor's work is finished and the Owner accepts, the Work will be complete and fit for the purpose intended by the Contract Documents. This acknowledgment and guarantee does not imply that the Contractor is assuming responsibilities of the Architect/Engineer.

3.2.6. Sufficiency of Contract Documents: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has received, carefully reviewed, and
evaluated all aspects of the Contract Documents and agrees that said Documents are adequate, consistent, coordinated, and sufficient for bidding and constructing the Work requested, intended, conceived, and contemplated therein.

3.2.6.1. The Contractor further acknowledges its continuing duty to review and evaluate the Contract Documents during the performance of its services and shall immediately notify the Architect/Engineer of any problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions it discovers in the Contract Documents and the Work to be constructed; and, any variances it discovers between the Contract Documents and applicable laws, statutes, building codes, rules or regulations.

3.2.6.2. If the Contractor performs any Work which it knows or should have known due to its experience, ability, qualifications, and expertise in the construction industry, that involves problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions in the Contract Documents and the Work to be constructed and, any variances between the Contract Documents and applicable laws, statutes, building codes, rules or regulations, without prior written notification to the Architect/Engineer and without prior authorization to proceed from the Architect/Engineer, the Contractor shall be responsible for and bare the costs and delays (including costs of any delay) of performing such Work and all corrective actions as directed by the Architect/Engineer.

3.2.6.3. Any and all claims resulting from the Contractor’s failure, including those of any subcontractor or supplier, to carefully review, evaluate, and become familiar with all aspects of the Contract Documents shall be deemed void and waived by the Contractor.

3.2.7. Sufficiency of Site Conditions: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has visited, carefully reviewed, evaluated, and become familiar with all aspects of the site and local conditions at which the Project is to be constructed. The Contractor agrees that the Contract Documents are an adequate, consistent, coordinated, and sufficient representation of the site and local conditions for the Work.

3.2.7.1. The Contractor has reviewed and become familiar with all aspects with the Site Survey and Geotechnical Report for the Project and has a full understanding of the information provided therein.

3.2.7.2. If the Work involves modifications, renovations, or remodeling of an existing structure(s) or other man-made feature(s), the Contractor certifies, warrants and guarantees that it has reviewed, evaluated, and become familiar with all available as-built and record drawings, plans and specifications, and has thoroughly inspected and become familiar with the structure(s) or man-made feature(s).

3.2.7.3. Any and all claims resulting from the Contractor’s failure, in including those of any subcontractor or supplier, to visit, carefully review, evaluate, and become familiar with all aspects of the site, available geotechnical information, and local conditions at which the Project is to be constructed shall be deemed void and waived by the Contractor.

3.3. SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.1. The Contractor shall supervise and direct the Work using the Contractor’s best skill and attention recognizing that time and quality are of the essence of the Work. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. It is the responsibility of and incumbent upon the Contractor to ensure, confirm, coordinate, inspect and oversee all Work (which is inclusive of but not limited to all submittals, change orders, schedules, workmanship, and appropriate staffing with enough competent and qualified personnel) so that the Work is not impacted in terms of any delays, costs, damages, or additional time, or effort on the part Architect/Engineer or Owner. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect/Engineer and shall not proceed with that portion of the Work without further written instructions from the Architect/Engineer. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Architect/Engineer or Owner as appropriate shall be solely responsible for
any resulting loss or damage. The Contractor will be required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and shall propose any alternative procedure which the Contractor will warrant and guarantee. The Contractor is required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and to propose any alternative procedure which the Contractor will warrant.

3.3.2. The Contractor shall furnish management, supervision, coordination, labor and services that: (1) expeditiously, economically, and properly completes the Work; (2) comply with all requirements of the Contract Documents; and, (3) are performed in a quality workmanlike manner and in accordance with the standards currently practiced by persons and entities performing or providing comparable management, supervision, labor and services on projects of similar size, complexity, cost, and nature to this Project. However, the standards currently practiced within the construction industry shall not relieve the Contractor of the responsibility to perform the Work to the level of quality, detail, and excellence defined and intended by the Contract Documents as interpreted by the Architect/Engineer.

3.3.3. All services and labor rendered by the Contractor, including any subcontractors or suppliers, shall be performed under the immediate supervision at the site of persons possessing expertise and the requisite knowledge in the discipline or trade of service being rendered. The Contractor shall maintain such supervision and personnel at all times that the Contractor’s personnel, subcontractors, and/or suppliers are at the site. The Contractor shall never be absent from the site during performance of any portion of the Work by any entity under the supervision and direction of the Contractor. Full time attendance by the Contractor from Notice to Proceed through Final Acceptance is an explicit requirement of this Contract.

3.3.4. The Contractor shall be responsible to the Owner for acts, damages, errors, and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.

3.3.5. The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

3.4. LABOR, WAGES, AND MATERIALS

3.4.1. Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, permits, licenses, goods, products, equipment, tools, construction equipment and machinery, water, heat, all utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work in accordance with the Contract Documents, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

3.4.2. The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order. This opportunity to request substitutions does not negate or waive any requirement for the Contractor to follow a pre-bidding “prior approval” requirement nor obligate the Owner to approve any substitution request.

3.4.3. The Contractor shall enforce strict discipline, appropriate behavior, and good order among the Contractor's employees, subcontractors at every tier and level, and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.4.4. Prevailing Wages and Montana Residents.

3.4.4.1. The Contractor and all subcontractors at any level or tier of the Work shall give preference to the employment of bona fide Montana residents in the performance of the Work and shall pay the standard prevailing rate of wages, including fringe benefits for health and welfare and pension contributions and travel allowance provisions in effect and applicable to the county or locality in which the work is being performed. (18-2-403, MCA)

3.4.4.2. At least 50% of the workers, as defined by the Department of Labor & Industry (DOLI), must be bona fide Montana residents. (18-2-401, 18-2-402, MCA)
3.4.4.3. Indian Employment Preference within the Boundaries of an Indian Reservation. All contractors that are awarded a state agency construction contract within the exterior boundaries of an Indian Reservation shall extend a hiring preference to qualified Indians as provided herein:

3.4.4.3.1. “State agency” means a department, office, board, bureau, commission, agency, or other instrumentality of the executive or judicial branches of the government of this State. “Indian” means a person who is enrolled or who is a lineal descendent of a person enrolled in an enrollment listing of the Bureau of Indian Affairs or in the enrollment listing of a recognized Indian tribe domiciled in the United States.

3.4.4.3.2. Qualified Indians – Employment Criteria: An Indian shall be qualified for employment in a permanent, temporary, or seasonal position if he or she has substantially equal qualifications for any position and resides on the reservation where the construction contract is to be performed.

3.4.4.3.3. Non-Applicability: The Indian Employment Preference Policy does not apply to a project partially funded with federal-aid money from the United States Department of Transportation or when residency preference laws are specifically prohibited by federal law. It does not apply to independent contractors and their employees, student interns, elected officials, or appointed positions.

3.4.4.4. The Commissioner of The Montana Department of Labor and Industry (DOLI) has established the standard prevailing rate of wages in accordance with 18-2-401 and 18-2-402, MCA. A copy of the Rates entitled "State of Montana, Prevailing Wage Rates" are bound herein. The Commissioner of the Montana DOLI has established the resident requirements in accordance with 18-2-409, MCA. The Contractor and all subcontractors at any level or tier of the Work shall direct any and all questions concerning prevailing wage and Montana resident issues for all aspects of the Work to DOLI.

3.4.4.5. The Contractor and all subcontractors at any tier or level of the Work, and as determined by the Montana DOLI, shall classify all workers in the project in accordance with the State of Montana, Prevailing Wage Rates. In the event the Contractor is unable to classify a worker in accordance with these rates he shall contact DOLI for a determination of the classification and the prevailing wage rate to be paid.

3.4.4.6. The Contractor and all subcontractors at any tier or level of the Work shall be responsible for obtaining wage rates for all workers prior to their performing any work on the project. The Contractor is required to pay and insure that its subcontractors at any tier or level and others also pay the prevailing wage determined by the DOLI, insofar as required by Title 18 of the MCA and the pertinent rules and standards of DOLI.

3.4.4.7. It is not the responsibility of the Owner to determine who classifies as a subcontractor, sub-subcontractor, material man, supplier, or any other person involved in any aspect of the Work at any tier or level. All such determinations shall be the sole responsibility of the Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project at any tier or level. The Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project shall indemnify and hold harmless the Owner from all claims, attorneys' fees, damages and/or awards involving prevailing wage or Montana resident issues. Any changes to wages or penalties for failure to pay the correct wages will be the sole responsibility of the Contractor and/or his subcontractors and no further charges or claims shall be made to the Owner. If the parties mutually agree or an arbitrator or court determines that any change in wages is due and any part is attributable to the Owner, the Owner's sole liability shall be for the amount of wages ordered only and not for other expenses, charges, penalties, overhead, profit or other mark-ups.

3.4.4.8. In accordance with 18-2-422(1) MCA, each job classification's standard prevailing wage rate, including fringe benefits, that the contractors and employers shall pay during construction of the project is included herein by both reference to DOLI's “Building” or ‘Heavy/Highway” schedules and as part of these Contract Documents.

3.4.4.9. The Contractor and every employer, including all subcontractors at any tier or level, is required by 18-2-422(2) MCA to maintain payroll records in a manner readily capable of being certified for submission under 18-2-423 MCA, for a period of not less than 3 years after the contractor's,
3.4.4.10. Each contractor is required by 18-2-422(3) MCA to post in a visible and accessible location a statement of all wages and fringe benefits in compliance with 18-2-423.

3.5. **WARRANTY AND GUARANTEE**

3.5.1. The Contractor warrants to the Owner and Architect/Engineer that materials and equipment furnished under the Contract will be new and of good quality unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and rejected. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect/Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

3.5.2. The Contractor shall and does hereby warrant and guarantee all work, workmanship, and materials for the full warranty period as specified in the Contract Documents. The warranty period shall be defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project by the Owner. The date of Final Acceptance shall be the date of the Architect/Engineer's signature on the final request for payment unless otherwise agreed upon in writing for the entire project or any portion thereof, by the Owner, Architect/Engineer and Contractor.

3.5.3. In addition to the one (1) calendar year warranty and guarantee specified in this herein above, the Contractor warrants and guarantees all materials and workmanship for the roofing system for a period of two (2) calendar years from the date of Final Acceptance. This warranty shall cover all labor and materials for roof and roofing finish systems (e.g. flashing, terminations, parapet caps, etc.) repairs from moisture penetration and/or defects in workmanship.

3.5.4. Manufacturer and product warranties and guarantees, as provided by the manufacturer or as specified in the Contract Documents, are in addition to the Contractor's warranty.

3.6. **TAXES**

3.6.1. The Contractor is responsible for and shall pay all sales, consumer, use, and similar taxes for the Work provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

3.6.2. In compliance with 15-50-206 MCA, the Contractor will have 1% of his gross receipts withheld by the Owner from all payments due and sent to the Montana Department of Revenue. Each subcontractor who performs work greater than $5,000 shall have 1% of its gross receipts withheld by the Contractor and sent to the Montana Department of Revenue. The Contractor shall notify the Department of Revenue on the Department's prescribed form.

3.7. **PERMITS, FEES, AND NOTICES**

3.7.1. Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay, either directly or through the appropriate subcontractor(s), for the building permit and other permits and governmental fees, licenses and inspections by authorities having jurisdiction for proper execution and completion of the Work which are customarily secured after execution of the Contract, including but not limited to, the building permit fee, electrical, plumbing, sewer connection fee and mechanical permit fee.

3.7.2. The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities applicable to performance of the Work.

3.7.3. If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations, and does so without providing notice to the Architect/Engineer and Owner, the Contractor shall assume responsibility for such Work and shall bear the costs attributable to correction. The
Contractor shall be solely responsible to insure that all work it performs is in full compliance with all prevailing and applicable codes and regulations.

3.7.4. Incident Reporting: The Contractor shall immediately notify the Owner and Architect/Engineer, both orally and in writing, of the nature and details of all incidents which may adversely affect the quality or progress of the Work, including, but not limited to, union disputes, accidents, delays, damages to Work, and other significant occurrences. Such notices are in addition to any other notices required regarding claims.

3.8. ALLOWANCES

3.8.1. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.

3.8.2. Unless otherwise provided in the Contract Documents and with specific reference to the calculation and approval of Allowance Work defined in Article 4.9 in the Pre-Construction Services Conditions:

3.8.2.1. allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

3.8.2.2. Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included by the Contractor in the Contract Sum but not in the allowances;

3.8.2.3. whenever costs are more than or less than stated allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect: (1) the difference between actual costs and the allowances under Clause 3.8.2.1; and, (2) changes in Contractor's costs under Clause 3.8.2.2.

3.8.3. Materials and equipment under an allowance shall be selected by the Owner.

3.9. CONTRACTOR'S PERSONNEL

3.9.1. The Contractor shall employ competent personnel, supervisors, project managers, project engineers, project superintendent, and all others who shall be assigned to the Work throughout its duration. Contractor's personnel extend to those employed by the Contractor whether at the site or not. The Owner shall have right to review and approve or reject all replacement of Contractor's personnel. All personnel assigned by the Contractor to the Work shall possess the requisite experience, skills, abilities, knowledge, and integrity to perform the Work.

3.9.2. The Contractor agrees that the employees identified in the response to GC/CM Request for Proposal (RFP) shall be fully and completely engaged to the extent stipulated in the Proposal response for the duration of the Project, except for catastrophic events including but not limited to termination of employment, illness, accident, or death. Any changes in the GC/CM Project Team members or roles should be agreed to with the Owner in writing.

3.9.3. The superintendent and others as assigned shall be in attendance at the Project site during the performance of any and all Work. The superintendent shall represent the Contractor. All communications given to the Contractor's personnel such as the project manager or the superintendent, whether verbal, electronic or written, shall be as binding as if given to the Contractor.

3.9.4. It is the Contractor's responsibility to appropriately staff, manage, supervise and direct the Work which is inclusive of the performance, acts, and actions of his personnel and subcontractors. As such, the Contractor further agrees to indemnify and hold harmless the Owner and the Architect/Engineer, and to protect and defend both from and against all claims, attorneys' fees, demands, causes of action of any kind or character, including the cost of defense thereof, arising in favor of or against the Owner, Architect/Engineer, Contractor, their agents, employees, or any third parties on account of the performance, behavior, acts or actions of the Contractor's personnel or subcontractors.

3.9.5. Prior to the commencement of any work, the Contractor shall prepare and submit a personnel listing and organizational chart in a format acceptable to the Owner which lists by name, phone number (including cell phone), job category, and responsibility the Contractor's key/primary personnel who will work on the Project.
The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference.

3.9.6. The Contractor shall immediately remove for the duration of the Project, any person making an inappropriate racial, sexual, or ethnic comment, statement, joke, or gesture toward any other individual.

3.9.7. The Contractor shall immediately remove for the duration of the Project, any person who is incompetent, careless, disruptive, or not working in harmony with others.

3.10. CONSTRUCTION SCHEDULES

3.10.1. The Contractor shall, promptly after being awarded the Contract, prepare and submit for the Owner's and Architect/Engineer's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and per the requirements of the Contract Documents, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The Contractor's schedule shall be in the "Critical Path Method" and shall show the Critical Path of the Work in sufficient detail to evaluate the Contractor's progress. A request for time extension by the Contractor will not be allowed unless a change in the Work is approved by the Owner and materially affects the Critical Path. It is the Contractor's responsibility to demonstrate that any time extensions requests materially affect the Critical Path.

3.10.2. The Contractor shall prepare and keep current, for the Architect/Engineer's approval, a schedule of submittals which is coordinated with the Contractor's Construction Schedule and allows the Architect/Engineer reasonable time to review submittals.

3.10.3. The Contractor shall perform the Work in accordance with the most recent schedule submitted to the Owner and Architect/Engineer.

3.10.4. The Contractor's operations (including but not limited to the Contractor's forces employed, sequences of operations, and methods of operation) at all times during the performance of the contract shall be: (a) subject to the review of the Owner or the Architect/Engineer; and, (b) sufficient to insure the completion of the Work within the specified performance period.

3.10.5. The Critical Path Method Construction Schedule prepared by the Contractor must be in a form that is acceptable to both the Architect/Engineer and the Owner.

3.10.5.1. The Schedule shall show the estimated progress of the entire Project through the individual time periods allowed for completion of each discipline, trade, phase, section, and aspect of the Work. The Contractor shall maintain and retain reports of all logic and resource loading data with the Schedule (and any revisions to the Schedule). Reports and resource loading data shall be provided to the Owner upon request.

3.10.5.2. The Schedule shall show percent complete, progress to date, project work, and projected time to complete the work for all activities. The percent complete and minor schedule changes, including additions of activities, change orders, construction change directives, changes to sequences of activities and significant changes in activity demands must be shown by a revised Schedule. A written report providing details about the changes and what actions are anticipated to get the work completed in the contractual time period shall be submitted with the revised schedule.

3.10.5.3. The Construction Schedule shall include coordinate dates for performance of all divisions of the Work, including shipping and delivery, off-site requirements and tasks, so the Work can be completed in a timely and orderly fashion consistent with the required dates of Substantial Completion and Final Acceptance.

3.10.5.4. The Construction Schedule shall include: (i) the required commencement date, the required dates of Substantial Completion(s) and Final Acceptance for the complete Project and all phases (if any); (ii) any guideline and milestone dates required by the Owner or the Contract Documents; (iii) subcontractor and supplier schedules; (iv) a submittal schedule which allows sufficient time for review.
3.10.5.5. By receiving, reviewing, and/or commenting on the Construction Schedule or any portion thereof (including logic and resource loading), neither the Owner or Architect/Engineer assume any of the Contractor’s responsibility or liability that the Schedule be coordinated or complete, or for timely and orderly completion of the Work.

3.10.5.6. Receiving, reviewing, and/or commenting on the Schedule, any portion thereof, or any revision thereof, does not constitute an approval, acknowledgement, or acceptance of any durations, dates, milestones, or performance indicated therein.

3.10.5.7. A printout of the Schedule’s logic showing all activities and all resource loading is required with the Schedule and with all updates to the Schedule.

3.10.6. The Contractor shall review and compare, at a minimum on a weekly basis, the actual status of the Work against its Construction Schedule.

3.10.7. The Contractor shall routinely, frequently, and periodically (but not less than monthly) update and/or revise its Construction Schedule to show actual progress of the Work through the date of the update or revision, projected level of completion of each remaining activity, activities modified since the previous update or revision, and major changes in scope or logic. The updated/revised Schedule shall be accompanied by a narrative report which: (1) states and explains any modifications of the critical path, if any, including any changes in logic; (2) defines problem areas and lists areas of anticipated delays; (3) explains the anticipated impact the change in the critical path or problems and delays will have on the entire Schedule and the completion of the Work; (4) provides corrective action taken or proposed; and, (5) states how problems or delays will be resolved in order to deliver the Work by the required phasing milestones (if any), Substantial Completion(s), and Final Acceptance dates.

3.10.8. Delay in Performance: If at any time the Contractor anticipates that performance of the Work will be delayed or has been delayed, the Contractor shall: (1) immediately notify the Architect/Engineer by separate and distinct correspondence of the probable cause and effect of the delay, and possible alternatives to minimize the delay; and, (2) take all corrective action reasonably necessary to deliver the Work by the required dates. Nothing in this paragraph or the Contract Documents shall be construed by the Contractor as a granting by the Architect/Engineer or Owner of constructive acceleration. The results of failure to anticipate delays, or to timely notify the Owner and Architect/Engineer of an anticipated or real delay, are entirely the responsibility of the Contractor whether compensable or not.

3.10.9. Early Completion: The Contractor may attempt to achieve Substantial Completion(s) on or before the date(s) required in the Contract. However, such early completion shall be for the Contractor’s sole convenience and shall not create any real or implied additional rights to Contractor or impose any additional obligations on the Owner or Architect/Engineer. The Owner will not be liable for nor pay any additional compensation of any kind to the Contractor for achieving Substantial Completion(s) or Final Acceptance prior to the required dates as set forth in the Contract. The Owner will not be liable for nor pay any additional compensation of any kind should there by any cause whatsoever that the Contractor is not able to achieve Substantial Completion(s) earlier than the contractually required dates of Substantial Completion(s) or Final Acceptance.

3.10.10. Float in Schedule. Any and all float time in the Contractor’s schedule, regardless of the path or activity, shall accrue to the benefit of the Owner and the Work, and not to the Contractor. Float also includes any difference shown between any early completion dates shown on the Contractor’s Schedule for any phasing milestone(s), Substantial Completion(s) or Final Acceptance and the dates or durations as required by the Contract Documents.

3.10.11. Modification of Required Substantial Completion(s) or Final Acceptance Dates: Modification of the required dates shall be accomplished only by duly authorized, accepted, and approved change orders stating the new date(s) with specificity on the change order form. All rights, duties, and obligations, including but not limited to the Contractor’s liability for actual, delay, and/or liquidated damages, shall be determined in relation to the date(s) as modified.

3.11. DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE
3.11.1. The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and accurately marked to record current field changes and selections made during construction, and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect/Engineer or Owner at any time and shall be delivered to the Architect/Engineer for submittal to the Owner upon completion of the Work.

3.11.2. The Owner shall not be required to process final payment until all documentation and data required by the Contract Documents is submitted to and approved by the Architect/Engineer including, but not limited to, the As-Built Drawings. The Owner will not process any final request for payment until the Architect/Engineer has received and verified that the Contractor has performed the requirements pertaining to the as-built drawings.

3.11.3. The as-built drawings shall be neatly and clearly marked during construction to record all deviations, variations, changes, and alterations as they occur during construction along with such supplementary notes and details necessary to clearly and accurately represent the as-built condition. The as-built drawings shall be available at all times to the Owner, Architect/Engineer and Architect/Engineer’s consultants.

3.12. **SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

3.12.1. Definitions:

3.12.1.1. Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

3.12.1.2. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

3.12.1.3. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.12.2. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect/Engineer is subject to the limitations of Subparagraph 4.2.7. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.

3.12.3. The Contractor shall review, approve, and submit to the Architect/Engineer, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents being issued the Notice To Proceed unless noted otherwise and shall do so in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Any and all items submitted by the Contractor which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor, or in the opinion of the Architect/Engineer, have not been reviewed for compliance by the Contractor even if marked as such, may be returned by the Architect/Engineer without action and shall not result in any accusation or claim for delay or cost by the Contractor. Any submittal that, in the opinion of the Architect/Engineer, is incomplete in any area or detail may be rejected and returned to the Contractor. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all submittals are complete, accurate, and in conformance to the Contract Documents prior to submission.

3.12.4. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents and guarantees to the Architect/Engineer and Owner that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

3.12.5. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer. Should the Contractor, Subcontractors or Sub-subcontractors install, construct, erect or perform any portion of the Work without approval of any requisite submittal, the
Contractor shall bear the costs, responsibility, and delay for removal, replacement, and/or correction of any and all items, material, and/or labor.

3.12.6. The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and: (1) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work; or, (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's approval thereof.

3.12.7. The Contractor shall direct specific attention, in writing or on re-submitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect/Engineer on previous submittals. In the absence of such written notice the Architect/Engineer's approval of a re-submission shall not apply to such revisions.

3.12.8. The Contractor shall not be required to provide professional services which constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect/Engineer will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect/Engineer. The Owner and the Architect/Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided the Owner and Architect/Engineer have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this subparagraph, the Architect/Engineer will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents but shall be responsible and held liable for review and verification of all performance or design criteria as required by Paragraph 3.2.

3.12.9. Unless noted otherwise in the Contract Documents, the Contractor shall submit to the Architect/Engineer within sixty (60) days from the date of the Notice To Proceed a minimum of six (6) complete copies of all shop/setting drawings, schedules, cut sheets, products, product data, and samples required for the complete Work. Copies shall be reviewed, marked, stamped and approved on each and every copy by the Contractor prior to submission to the Architect/Engineer or they shall be returned without review or action. The Architect/Engineer shall review with reasonable promptness, making corrections, rejections, or other actions as appropriate. The Architect/Engineer's approval or actions on shop/setting drawings, schedules, cut sheets, products, product data, or samples shall not relieve the Contractor from responsibility for, nor deviating from, the requirements of the plans and specifications. Any deviations from the plans and specifications requested or made by the Contractor shall be brought promptly to the attention of the Architect/Engineer.

3.12.10. Cost for Re-Submissions: the Contractor is responsible for ensuring that all shop drawings, product data, samples, and submittals contain all information required by the Contract Documents to allow the Architect/Engineer to take action. The Contractor shall pay the Architect/Engineer's cost for any re-submission of any rejected item. Such costs shall be deducted from the contract sum by Change Order. The Contractor agrees that any action taken by the Architect/Engineer is solely in the Architect/Engineer's discretion and is non-negotiable for the purposes of the Architect/Engineer's cost recovery for multiple (i.e. more than one) review.

3.13. USE OF SITE
3.13.1. The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

3.13.2. The Contractor shall not damage, endanger, compromise or destroy any part of the Project or the site, including but not limited to work performed by others, monuments, stakes, bench marks, survey points, utilities, existing features or structures. The Contractor shall be fully and exclusively responsible for and bare all costs and delays (including and costs of delay) for any damage, endangerment, compromise, or destruction of any part of the Project or site.

3.13.3. The Contractor shall adhere to all MSU-Bozeman Vehicle Regulations as follows:

3.13.3.1. All students, faculty, staff, and visitors must register any motor vehicle they park on the University campus, for any reason. A visitor is anyone not defined as student, staff or faculty.

3.13.3.2. All Contractor and Contractor employees shall comply with Montana State University parking regulations. MSU parking permits can be purchased at the Huffman Building at Seventh Avenue and Kagy Boulevard. Contractor should call University Police at 994-2121 for permit information. Violators of MSU Bozeman Vehicle Regulations may be ticketed and towed.

3.13.3.3. Unless otherwise indicated on the drawings, all Contractor and Contractor employee vehicles on campus shall be parked in designated parking lots. If allowed on the drawings, vehicles to a maximum number stated, may be parked in project site areas designated and shall only be Contractor vehicles with company signs clearly visible. No personal vehicles shall be parked at the project site in any case. If a driver of a vehicle not allowed to be parked at the project site must unload equipment, tools, or materials, the vehicle must be immediately thereafter moved to a designated lot or leave campus. Vehicles parked in the project site, other than those allowed on the drawings, may be ticketed and towed.

3.13.3.4. Access to the project site shall be only by the route designated on the drawings. In cases where a different route must be used for a specific purpose, permission must be obtained from Owner. In no case will vehicles be used on the Centennial Mall paving. Access routes are for delivery of equipment, tools, and not for parking.

3.13.3.5. Site staging areas for materials and equipment if permitted, will be designated on the drawings if permitted. If not designated, staging is intended to be in the construction area boundaries. Staged materials and equipment must be secured on the ground surface or in trailers. Site staging areas shall be fenced.

3.13.4. The Contractor shall coordinate his operations with the Owner in order that the Owner will have maximum use of existing facilities surrounding the area of the Work, as agreed upon, at all times during normal working hours. Contractor further agrees to coordinate his operations so as to avoid interference with the Owner’s normal operations to as great an extent as possible.

3.14. CUTTING AND PATCHING

3.14.1. The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

3.14.2. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.15. CLEAN UP AND SITE CONTROL

3.15.1. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract during performance of the Work and at the direction of the Owner or Architect/Engineer. At completion of the Work, the Contractor shall remove from and about the
Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

3.15.2. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.16. ACCESS TO WORK

3.16.1. The Contractor shall provide the Owner and Architect/Engineer access to the Work at all times wherever located.

3.17. ROYALTIES, PATENTS AND COPYRIGHTS

3.17.1. The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect/Engineer harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect/Engineer. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect/Engineer.

3.18. INDEMNIFICATION

3.18.1. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys’ fees, arising out of or resulting from performance of the Work to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph. The Contractor agrees that it will defend, protect, indemnify and save harmless the State of Montana and the Owner against and from all claims, liabilities, demands, causes of action, judgments (including costs and reasonable attorneys’ fees), and losses from any cause whatever (including patent, trademark and copyright infringement) except the Owner’s sole or partial negligence. This includes any suits, claims, actions, losses, costs, damages of any kind, including the State and Owner’s legal expenses, arising out of, in connection with, or incidental to the Contract, but does not include any such suits, claims, actions, losses, costs or damages which are the result of the negligent acts, actions, losses, costs, or damages which are acts, omissions or misconduct of the Owner if they do not arise out of, depend upon or relate to a negligent act, omission or misconduct of the Contractor in whole or in part.

3.18.2. In claims against any person or entity indemnified under this Paragraph 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Subparagraph 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

4. ARTICLE 4 – ADMINISTRATION OF THE CONSTRUCTION CONTRACT

4.1. THE ARCHITECT/ENGINEER

4.1.1. The Architect/Engineer is the person lawfully licensed to practice or an entity lawfully practicing identified as such in the Agreement with the Owner and is referred to throughout the Contract Documents as if singular in number. The term “Architect/Engineer” means the Architect/Engineer’s duly authorized representative.

4.1.2. Duties, responsibilities and limitations of authority of the Architect/Engineer as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner.

4.1.3. If the employment of the Architect/Engineer is terminated, the Owner shall employ a new Architect/Engineer at the sole choice and discretion of the Owner, whose status under the Contract Documents shall be that of the former Architect/Engineer.
4.2. ARCHITECT/ENGINEER’S ADMINISTRATION OF THE CONSTRUCTION CONTRACT

4.2.1. The Architect/Engineer will provide administration of the Contract as described in the Contract Documents, and will be an Owner's representative throughout the complete duration of the Project, including the warranty period. The Architect/Engineer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with the Architect/Engineer Contract.

4.2.2. The Architect/Engineer, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations to: (1) become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed; (2) endeavor to guard the Owner against defects and deficiencies in the Work; and, (3) to determine in general if the Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Owner and Architect/Engineer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Contractor's Work. The Owner and Architect/Engineer will neither have control over or charge of, nor be responsible for, the construction means, methods, techniques, sequences or procedures, for the safety of any person involved in the work, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

4.2.3. The Architect/Engineer will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect/Engineer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

4.2.4. Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect/Engineer about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor to the Architect/Engineer. Communications by and with separate contractors shall be through the Owner to the Architect/Engineer.

4.2.5. Based on the Architect/Engineer's evaluations of the Contractor's Applications for Payment, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts. The Contractor is fully aware that the Owner (i.e. the State of Montana) has established a billing cycle for processing payments in Article 9 of these General Conditions. The Contractor and all Subcontractors are subject to all provisions of Title 28, Chapter 2, Part 21 MCA regarding all aspects of the Work.

4.2.6. The Architect/Engineer will have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect/Engineer considers it necessary or advisable, the Architect/Engineer will have authority to require inspection or testing of the Work in accordance with the General Conditions and any applicable technical specification requirements, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect/Engineer nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect/Engineer to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

4.2.7. The Architect/Engineer will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect/Engineer's action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect/Engineer's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Paragraphs 3.3, 3.5 and 3.12. The Architect/Engineer's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any
4.2.8. The Architect/Engineer will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Paragraph 7.4.

4.2.9. The Architect/Engineer will conduct inspections to determine the date or dates of Substantial Completion(s) and the date of Final Acceptance, will receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

4.2.10. If the Owner and Architect/Engineer agree, the Architect/Engineer will provide one or more project representatives to assist in carrying out the Architect/Engineer's responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in the Owner's Agreement with the Architect/Engineer.

4.2.11. The Architect/Engineer will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor. The Architect/Engineer's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect/Engineer shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect/Engineer to furnish such interpretations until 15 days after written request is made for them.

4.2.12. Interpretations and decisions of the Architect/Engineer will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and initial decisions, the Architect/Engineer will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will render such interpretations and decisions in good faith.

4.2.13. The Architect/Engineer's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

4.2.14. The Architect/Engineer's or Owner's observations or inspections do not alleviate any responsibility on the part of the Contractor. The Architect/Engineer and the Owner reserves the right to observe and inspect the work and make comment. Action or lack of action following observation or inspection is not to be construed as approval of Contractor's performance.

4.3. CLAIMS AND DISPUTES

4.3.1. Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extensions of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes, controversies, and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest solely with the party making the Claim.

4.3.1.1. Time Limits on Claims. Claims by either party must be initiated within 21 calendar days after occurrence of the event giving rise to such claim. The following shall apply to the initiation of a claim:

4.3.1.1.1. A written notice of a claim must be provided to the Architect/Engineer and the other party within 21 calendar days after the occurrence of the event or the claim is waived by the claiming party and void in its entirety.

4.3.1.1.2. Claims must be initiated by separate, clear, and distinct written notice within the 21 calendar day time frame to the Architect/Engineer and the other party and must contain the notarized statement in Sub-Paragraph 4.3.1.5 when the claim is made by the Contractor. Discussions in any form with the Architect/Engineer or Owner, whether at the site or not, do not constitute initiation of a claim. Notes in project meeting minutes, email correspondence, change order proposals, or any other form of documentation does not constitute initiation of a claim. The written notice must be a separate and distinct correspondence provided in hardcopy to both the Architect/Engineer and Owner and must delineate the specific event and outline the causes and
reasons for the claim whether or not cost or time have been fully determined. Written remarks or notes of a generic nature are invalid in their entirety. Comments made at progress meetings, project site visits, inspections, emails, voice mails, and other such communications do not meet the requirement of providing notice of claim.

4.3.1.1.3. Physical Injury or Physical Damage. Should the Owner or Contractor suffer physical injury or physical damage to person or property because of any error, omission, or act of the other party or others for whose acts the other party is legally and contractually liable, claim will be made in writing to the other party within a reasonable time of the first observance of such physical injury or physical damage but in no case beyond 30 calendar days of the first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose. In all such cases, the indemnification provisions of the Contract shall be effectual and the Contractor’s insurance shall be primary and in full effect.

4.3.1.2. All Claims must contain sufficient justification and substantiation with the written notice or they may be rejected without consideration by the Architect/Engineer or other party with no additional impact or consequence to the Contract Sum, Contract Time, or matter(s) in question in the Claim.

4.3.1.3. If additional compensation is claimed, the exact amount claimed and a breakdown of that amount into the following categories shall be provided with each and every claim:

4.3.1.3.1. Direct costs (as listed in Subparagraph 7.3.9.1 through 7.3.9.5);

4.3.1.3.2. Indirect costs (as defined in Paragraph 7.2.5); and,

4.3.1.3.3. Consequential items (i.e. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution) for the change.

4.3.1.4. If additional time is claimed the following shall be provided with each and every claim:

4.3.1.4.1. The specific number of days and specific dates for which the additional time is sought;

4.3.1.4.2. The specific reasons, causes, and/or effects whereby the Contractor believes that additional time should be granted; and,

4.3.1.4.3. The Contractor shall provide analyses, documentation, and justification of its claim for additional time in accordance with the latest Critical Path Method schedule in use at the time of event giving rise to the claim.

4.3.1.5. With each and every claim, the Contractor shall submit to the Architect/Engineer and Owner a notarized statement containing the following language:

4.3.2. “Under penalty of law (including perjury and/or false/fraudulent claims against the State), the undersigned,

(Name) ____________________ (Title) __________________
Of __________________________ (Company) __________________
(Date) ______________________

hereby certifies, warrants, and guarantees that this claim made for Work on this Contract is a true statement of the costs, adjustments and/or time sought and is fully documented and supported under the contract between the parties.

(Signature) ____________________ (Date) __________________

4.3.3. Continuing Contract Performance.
4.4. Pending final resolution of a Claim except as otherwise agreed in writing or as provided in Subparagraph 9.7.1 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents on the portion of the Work not involved in a Claim.

4.4.1. Claims for Cost or Time for Concealed or Unknown Conditions.

4.5. If conditions are encountered at the site which are: (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents; or, (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed.

4.5.1.1. The Architect/Engineer will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor’s cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect/Engineer determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect/Engineer shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the date of the Architect/Engineer’s decision.

4.5.1.2. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect/Engineer for initial determination, subject to further proceedings pursuant to Paragraph 4.4.

4.5.1.3. Nothing in this paragraph shall relieve the Contractor of its obligation to adequately and sufficiently investigate, research, and examine the site, the site survey, topographical information, and the geotechnical information available whether included by reference or fully incorporated in the Contract Documents.

4.5.2. Claims for Additional Cost.

4.5.2.1. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.6.

4.5.2.2. If the Contractor believes additional cost is involved for reasons including but not limited to: (1) a written interpretation from the Architect/Engineer; (2) an order by the Owner to stop the Work solely for the Owner’s convenience or where the Contractor was not at least partially at fault; (3) a written order for a minor change in the Work issued by the Architect/Engineer; (4) failure of payment by the Owner per the terms of the Contract; (5) termination of the Contract by the Owner; or, (6) other reasonable grounds, Claim must be filed in accordance with this Paragraph 4.3.

4.5.3. Claims for Additional Time

4.5.3.1. If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as specified in these General Conditions shall be provided along with the notarized certification. The Contractor’s Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay for the same event or cause only one Claim is necessary. However, separate and distinct written notice is required for each separate event.

4.5.3.2. Weather Delays:

4.5.3.2.1. If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction activities.

4.5.3.2.2. Inclement or adverse weather shall not be a prima facie reason for the granting of an extension of time, and the Contractor shall make every effort to continue work under prevailing conditions.
conditions. The Owner may grant an extension of time if an unavoidable delay occurs as a result of inclement/severe/adverse weather and such shall then be classified as a “Delay Day”. Any and all delay days granted by the Owner are and shall be non-compensable in any manner or form. The Contractor shall comply with the notice requirements concerning instances of inclement/severe/adverse weather before the Owner will consider a time extension. Each day of inclement/severe/adverse weather shall be considered a separate instance or event and as such, shall be subject to the notice requirements.

4.5.3.2.3. An “inclement”, “severe”, or “adverse” weather delay day is defined as a day on which the Contractor is prevented by weather or conditions caused by weather resulting immediately there from, which directly impact the current controlling critical-path operation or operations, and which prevent the Contractor from proceeding with at least 75% of the normal labor and equipment force engaged on such critical path operation or operations for at least 60% of the total daily time being currently spent on the controlling operation or operations.

4.5.3.2.4. The Contractor shall consider normal/typical/seasonal weather days and conditions caused by normal/typical/seasonal weather days for the location of the Work in the planning and scheduling of the Work to ensure completion within the Contract Time. No time extensions will be granted for the Contractor’s failure to consider and account for such weather days and conditions caused by such weather for the Contract Time in which the Work is to be accomplished.

4.5.3.2.5. A “normal”, “typical”, or “seasonal” weather day shall be defined as weather that can be reasonably anticipated to occur at the location of the Work for each particular month involved in the Contract Time. Each month involved shall not be considered individually as it relates to claims for additional time due to inclement/adverse/severe weather but shall consider the entire Contract Time as it compares to normal/typical/seasonal weather that is reasonably anticipated to occur. Normal/typical/seasonal weather days shall be based upon U.S. National Weather Service climatic data for the location of the Work or the nearest location where such data is available.

4.5.3.2.6. The Contractor is solely responsible to document, prepare and present all data and justification for claiming a weather delay day. Any and all claims for weather delay days shall be tied directly to the current critical-path operation or operations on the day of the instance or event which shall be delineated and described on the Critical-Path Schedule and shall be provided with any and all claims. The Contractor is solely responsible to indicate and document why the weather delay day(s) claimed are beyond those weather days which are reasonably anticipated to occur for the Contract Time. Incomplete or inaccurate claims, as determined by the Architect/Engineer or Owner, may be returned without consideration or comment.

4.5.3.3. Where the Contractor is prevented from completing any part of the Work with specified durations or phases due to delay beyond the control of both the Owner and the Contractor, an extension of the contract time or phase duration in an equal amount to the time lost due to such delay shall be the Contractor’s sole and exclusive remedy for such delay.

4.5.3.4. Delays attributable to and/or within the control of subcontractors and suppliers are deemed to be within the control of the Contractor.

4.5.3.5. In no event shall the Owner be liable to the Contractor, any subcontractor, any supplier, Contractor’s surety, or any other person or organization, for damages or costs arising out of or resulting from: (1) delays caused by or within the control of the Contractor which include but are not limited to labor issues or labor strikes on the Project, federal, state, or local jurisdiction enforcement actions related directly to the Contractor’s Work (e.g. safety or code violations, etc.); or, (2) delays beyond the control of both parties including but not limited to fires, floods, earthquakes, abnormal weather conditions, acts of God, nationwide material shortages, actions or inaction by utility owners, emergency declarations by federal, state, or local officials enacted in the immediate vicinity of the project, or other contractors performing work for the Owner.

4.5.4. **Claims for Consequential Damages**

4.5.4.1. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes:
4.5.4.1.1. damages incurred by the Owner for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and,

4.5.4.1.2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, income, and for loss of profit.

4.5.4.2. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this waiver of consequential damages shall be deemed to preclude an award of liquidated or actual damages, when applicable, in accordance with the requirements of the Contract Documents.

4.6. RESOLUTION OF CLAIMS, DISPUTES, AND CONTROVERSIES

4.6.1. Decision of Architect/Engineer. Claims, including those alleging an error or omission by the Architect/Engineer, shall be referred initially to the Architect/Engineer for decision. A decision by the Architect/Engineer shall be required as a condition precedent to mediation, arbitration or litigation of all Claims between the Contractor and Owner arising prior to the date of Final Acceptance, unless 30 days have passed after the Claim has been referred to the Architect/Engineer with no decision having been rendered by the Architect/Engineer. The Architect/Engineer will not decide disputes between the Contractor and persons or entities other than the Owner. Any Claim arising out of or related to the Contract, except those already waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, pending compliance with Subparagraph 4.4.5, be subject to mediation, arbitration, or the institution of legal or equitable proceedings. Claims waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4, and 9.10.5 are deemed settled, resolved, and completed.

4.6.2. The Architect/Engineer will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party; (2) reject the Claim in whole or in part; (3) approve the Claim; (4) suggest a compromise; or (5) advise the parties that the Architect/Engineer is unable to resolve the Claim if the Architect/Engineer lacks sufficient information to evaluate the merits of the Claim or if the Architect/Engineer concludes that, in the Architect/Engineer's sole discretion, it would be inappropriate for the Architect/Engineer to resolve the Claim.

4.6.3. If the Architect/Engineer requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond within ten (10) days after receipt of such request and shall either provide a response on the requested supporting data, advise the Architect/Engineer when the response or supporting data will be furnished, or advise the Architect/Engineer that no supporting data will be furnished. Upon either no response or receipt of the response or supporting data, the Architect/Engineer will either reject or approve the Claim in whole or in part.

4.6.4. The Architect/Engineer will approve or reject Claims by written decision, which shall state the reasons therefor and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect/Engineer shall be final and binding on the parties but subject to mediation and arbitration.

4.6.5. When 30 days have passed upon submission of a Claim without decision or action by the Architect/Engineer, or the Architect/Engineer has rendered a decision or taken any of the actions identified in Subparagraph 4.4.2, a demand for arbitration of a Claim covered by such decision or action must be made within 30 days after the date of expiration of Subparagraph 4.4.1 or within 30 days of the Architect/Engineer's decision or action. Failure to demand arbitration within said 30 day period shall result in the Architect/Engineer's decision becoming final and binding upon the Owner and Contractor whenever such decision is rendered.

4.6.6. If the Architect/Engineer renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.

4.6.7. Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the 2014-02-07 General Conditions of the Contract for Construction - Final 06-17-2015
Claim relates to a possibility of a Contractor's default, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

4.6.8. A Claim subject to or related to liens or bonds shall be governed by applicable law regarding notices, filing deadlines, and resolution of such Claim prior to any resolution of such Claim by the Architect/Engineer, by mediation, or by arbitration, except for claims made by the Owner against the Contractor's bonds.

4.7. MEDIATION

4.7.1. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, after initial decision by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.

4.7.2. The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect and/or those rules specified in the contract documents or separately agreed upon between the parties. Construction Industry Mediation Rule M-2 (filing with AAA) is void. The parties shall mutually agree upon a mediator who shall then take the place of AAA in the Construction Industry Mediation Rules. The parties must mutually agree to use AAA and no filing of a request for mediation shall be made to AAA by either party until such mutual agreement has been made. Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association. The request may be made concurrently with the filing of a demand for arbitration but, in such event, mediation shall proceed in advance of arbitration or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

4.7.3. The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

4.8. ARBITRATION

4.8.1. Any controversy or Claim arising out of or related to this Contract or the breach thereof shall be settled by arbitration in accordance with the Montana Uniform Arbitration Act (MUAA). To the extent it does not conflict with the MUAA, the Construction Industry Arbitration Rules of the American Arbitration Association shall apply except as modified herein. The parties to the arbitration shall bear their own costs and expenses for participating in the arbitration. Costs of the Arbitration panel shall be borne equally between the parties except those costs awarded by the Arbitration panel (including costs for the arbitration itself).

4.8.2. Prior to the arbitration hearing all parties to the arbitration may conduct discovery subject to the provisions of Montana Rules of Civil Procedure. The arbitration panel may award actual damages incurred if a party fails to provide full disclosure under any discovery request. If a party claims a right of information privilege protected by law, the party must submit that claim to the arbitration panel for a ruling, before failing to provide information requested under discovery or the arbitration panel may award actual damages.

4.8.3. The venue for all arbitration proceedings required by this Contract shall be the seat of the county in which the work occurs or the First Judicial District, Lewis & Clack County, as determined solely by the Owner. Arbitration shall be conducted by a panel comprised of three members with one selected by the Contractor, one selected by the Owner, and one selected by mutual agreement of the Owner and the Contractor.

4.8.4. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5, shall, after decision or action by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to arbitration provided a demand for arbitration is made within the time frame provided in Subparagraph 4.4.5. If such demand is not made with the specified time frame, the Architect/Engineer's decision or action is final. Prior to arbitration, the parties shall endeavor to resolve disputes by mediation in accordance with the provisions of Paragraph 4.5.

4.8.5. Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American

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Arbitration Association currently in effect and/or those rules specified in the Contract Documents or separately agreed upon between the parties. Construction Industry Arbitration Rule R-3 (filing with AAA) is void. The parties shall mutually agree upon an arbitrator or arbitrators who shall then take the place of AAA in the Construction Industry Arbitration Rules. The parties must mutually agree to use AAA and no filing of a demand for arbitration shall be made to AAA by either party until such mutual agreement has been made. The demand for arbitration shall be filed in writing with the other party to the Contract and a copy shall be filed with the Architect/Engineer.

4.8.6. A demand for arbitration shall be made within the time limits specified in Subparagraphs 4.4.5 and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Paragraph 13.7.

4.8.7. Pending final resolution of a Claim including arbitration, unless otherwise mutually agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract on Work or amounts not in dispute.

4.8.8. Limitation on Consolidation or Joinder. Arbitration arising out of or relating to the Contract may include by consolidation or joinder the Architect/Engineer, the Architect/Engineer's employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Architect/Engineer, Owner, Contractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Architect/Engineer, Contractor, a separate contractor as described in Article 6 and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Architect/Engineer, Contractor or a separate contractor as described in Article 6 shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

4.8.9. Claims and Timely Assertion of Claims. The party filing a demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

4.8.10. Judgment on Final Award. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof. The parties agree that the costs of the arbitrator(s’) compensation and expenses shall be borne equally. The parties further agree that the arbitrator(s) shall have authority to award to either party some or all of the costs and expenses involved, including attorney’s fees.

5. ARTICLE 5 – SUBCONTRACTORS

5.1. DEFINITIONS

5.1.1. A Subcontractor is a person or entity who has a direct or indirect contract at any tier or level with the Contractor or any Subcontractor to the Contractor to perform a portion of the Work at the site. The term “Subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term “Subcontractor” does not include a separate contractor or subcontractors of a separate contractor.

5.2. AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1. Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract and in no instance later than (30) days after award of the Contract, shall furnish in writing to the Owner through the Architect/Engineer the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect/Engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect/Engineer, after due investigation, has reasonable objection to any such proposed person or entity.
5.2.2. The Contractor shall not contract with a proposed person or entity to which the Owner or Architect/Engineer has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

5.2.3. If the Owner or Architect/Engineer has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect/Engineer has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

5.2.4. The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect/Engineer makes reasonable objection to such substitute. The Contractor shall not change or substitute for a Subcontractor who was required to be listed on the bid without first getting the approval of the Owner.

5.3. SUBCONTRACTUAL RELATIONS

5.3.1. By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect/Engineer. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect/Engineer under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement which may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

5.3.2. Upon written request by the Owner, the Contractor shall require its subcontractors to provide to it performance and payment securities for their portion of the Work in the types and form defined in statute (18-2-201 and 18-2-203 MCA) for all sub-contractual agreements.

5.3.3. The Contractor shall prepare a Subcontractors' and Suppliers' chart in CSI division format acceptable to the Owner which lists by name, all contact information, job category, and responsibility the Contractor's Subcontractors (at all tiers or levels) and Suppliers with a pecuniary interest in the Project of greater than $5,000.00. The Contractor shall not enter into any agreement with any subcontractor or supplier to which the Owner raises a timely objection. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference but no less than 30 days after award of the Contract.

5.3.4. All Contractors and Subcontractors to this contract must comply with all Montana Department of Labor and Industry requirements, regulations, rules, and statutes.

5.3.5. In compliance with state statutes, the Contractor will have the 1% Gross Receipts Tax withheld from all payments. Each “Public Contractor” includes all Subcontractors with contracts greater than $5,000 each. The Contractor and all Subcontractors will withhold said 1% from payments made to all Subcontractors with contracts greater than $5,000.00 and make it payable to the Montana Department of Revenue. The Contractor and all Subcontractors shall also submit documentation of all contracts greater than $5,000.00 to the Montana Department of Revenue on the Department’s prescribed form.

5.4. CONTINGENT ASSIGNMENT OF SUBCONTRACTS

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5.4.1. Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner provided that:

5.4.1.1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Paragraph 14.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor and Contractor in writing; and,

5.4.1.2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

5.4.2. Upon such assignment, if the Work has been suspended for more than 30 days as a result of the Contractor's default, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension. Such adjustment shall be at the expense of the Contractor.

5.4.3. The Contractor shall engage each of its subcontractors and suppliers with written contracts that preserve and protect the rights of the Owner and include the acknowledgement and agreement of each subcontractor and supplier that the Owner is a third-party beneficiary of their sub-contractual and supplier agreements. The Contractor's agreements shall require that in the event of default by the Contractor or termination of the Contract, and upon request of the Owner, the Contractor's subcontractors and suppliers will perform services for the Owner.

5.4.4. Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

6. ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1. OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Paragraph 4.3.

6.1.2. When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

6.1.3. The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

6.1.4. Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights which apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

6.2. MUTUAL RESPONSIBILITY

6.2.1. The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

6.2.2. If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work,
promptly report to the Architect/Engineer apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

6.2.3. The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

6.2.4. The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Subparagraph 10.2.5.

6.2.5. The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Subparagraph 3.14.

6.3. OWNER'S RIGHT TO CLEAN UP

6.3.1. If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect/Engineer will determine the responsibility of those involved and allocate the cost accordingly.

7. ARTICLE 7 – CHANGES IN THE WORK

7.1. GENERAL

7.1.1. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive, or order for a minor change in the Work subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Minor changes as ordered by the Architect/Engineer has the definition provided in Paragraph 7.4.

7.1.2. A Change Order shall be based upon agreement among the Owner, Contractor, and Architect/Engineer; a Construction Change Directive requires agreement by the Owner and Architect/Engineer and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect/Engineer alone.

7.1.3. Changes in the Work shall be performed under applicable provisions of the Contract Documents and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

7.1.4. No act, omission, or course of dealing, shall alter the requirement that Change Orders or Construction Change Directives shall be in writing and signed by the Owner, and that Change Orders and Construction Change Directives are the exclusive method for effecting any adjustment to the Contract. The Contractor understands and agrees that neither the Contract Sum nor the Contract Time can be changed by implication, oral agreement, verbal directive, or unsigned Change Order.

7.2. CHANGE ORDERS

7.2.1. A Change Order is a written instrument prepared by the Architect/Engineer and signed by the Owner, Contractor and Architect/Engineer, stating their agreement upon all of the following:

7.2.1.1. change in the Work;
7.2.1.2. the amount of the adjustment, if any, in the Contract Sum; and,
7.2.1.3. the extent of the adjustment, if any, in the Contract Time.

7.2.2. The cost or credit to the Owner resulting from a change in the Work shall be determined as follows:
7.2.2.1. Per the limitations of this Subparagraph, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive; or,

7.2.2.2. By one of the methods in Subparagraph 7.3.4, or as determined by the Architect/Engineer per Subparagraph 7.3.9, plus a maximum allowance of [TO BE ESTABLISHED BY EARLY WORK AMENDMENT(S) AND/OR GMP AMENDMENT] overhead and profit for the GC/CM. Subcontractors shall be limited to a maximum allowance of [TO BE ESTABLISHED BY EARLY WORK AMENDMENT(S) AND/OR GMP AMENDMENT] overhead and profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive.

7.2.2.3. The Contractor’s proposed increase or decrease in cost shall be limited to costs listed in Subparagraph 7.3.9.1 through 7.3.9.5.

7.2.3. The Contractor shall not submit any Change Order, response to requested cost proposals, or requested changes which are incomplete and do not contain full breakdown and supporting documentation in the following three areas:

7.2.3.1. Itemized direct costs (only those listed in Subparagraph 7.3.9.1 through 7.3.9.5 are allowable);

7.2.3.2. Itemized indirect costs (limited as a percentage on each Change Order per Supplementary General Conditions, Paragraph 7.2.2); and

7.2.3.3. Itemized consequential items (e.g. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution).

7.2.4. Any Change Order, responses to requested proposals, or requested changes submitted by the Contractor which, in the opinion of the Architect/Engineer, are incomplete, may be rejected and returned to the Contractor without comment. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all Change Orders, responses to requested proposals, or requested changes are complete prior to submission.

7.2.5. Overhead, applicable to all areas and sections of the Contract Documents, means “Indirect Costs” as referenced in Subparagraph 7.2.3.2. Indirect costs are inclusive of, but not limited to, the following: home office overhead; off-site supervision; home office project management; change order and/or proposal preparation, design, research, negotiation and associated travel; effects of disruption and dilution of management and supervision off-site; time delays; coordination of trades; postage and shipping; and, effective increase in guarantee and warranty durations. Indirect costs applicable to any and all changes in the work, either through Change Order or Construction Change Directive, are limited to the percentage allowance for overhead in Subparagraph 7.2.2.

7.2.6. By signature on any Change Order, the Contractor certifies that the signed Change Order is complete and includes all direct costs, indirect costs and consequential items (including additional time, if any) and is free and clear of all claims or disputes (including, but not limited to, claims for additional costs, additional time, disruptions, and/or impacts) in favor of the Contractor, subcontractors, material suppliers, or other persons or entities concerning the signed change order and on all previously contracted Work and does release the Owner from such claims or demands.

7.2.7. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Change Order shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor’s most recent Critical Path Schedule in use prior to the change. Changes which affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time, shall not result in an increase in the Contract Time.

7.2.8. Supervision means on-site, field supervision and not home office overhead, off-site management or off-site supervision.
7.2.9. Labor means those persons engaged in construction occupations as defined in Montana Prevailing Wage Rates for Building Construction or Heavy/Highway as bound in the Contract Documents and does not include design, engineering, superintendence, management, on-site field supervision, home office or other off-site management, off-site supervision, office or clerical work.

7.3. CONSTRUCTION CHANGE DIRECTIVES

7.3.1. A Construction Change Directive is a written order prepared by the Architect/Engineer directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

7.3.2. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Construction Change Directive, shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes that affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time shall not result in an increase in the Contract Time.

7.3.3. A Construction Change Directive shall be used in the absence of agreement on the terms of a Change Order.

7.3.4. If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

7.3.4.1. mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

7.3.4.2. unit prices stated in the Contract Documents or subsequently agreed upon;

7.3.4.3. cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee;

7.3.4.4. By actual cost as shown by the Contractor's and Subcontractor's itemized invoices; or

7.3.4.5. as provided in Subparagraph 7.3.9.

7.3.5. Costs shall be limited to the following: cost of materials, including cost of delivery; cost of labor, including social security, old age and unemployment insurance and fringe benefits under collective bargaining agreements; workers' compensation insurance; bond premiums; and rental value of power tools and equipment.

7.3.6. Overhead and profit allowances shall be limited on all Construction Change Directives to those identified in 7.2.2.

7.3.7. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect/Engineer of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

7.3.8. A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3.9. If the Contractor does not respond or disagrees with the method for adjustment in the Contract Sum in writing within seven (7) calendar days, the method and the adjustment made shall be determined by the Architect/Engineer on the basis of reasonable expenditures and/or savings of those performing the Work directly attributable to the change including, in the case of an increase in the Contract Sum, plus an allowance for overhead and profit as listed under Subparagraph 7.2.2. In such case, and also under Clause 7.3.4.3, the Contractor shall keep and present, in such form as the Architect/Engineer may prescribe, an
itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 7.3.9 shall be limited to the following:

7.3.9.1. costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers’ compensation insurance as determined by the Prevailing Wage Schedules referenced in the Contract Documents;
7.3.9.2. costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
7.3.9.3. rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
7.3.9.4. costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
7.3.9.5. additional costs of field supervision and field office personnel directly attributable to the change.

7.3.10. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect/Engineer. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

7.3.11. Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied by a Change Order indicating the parties’ agreement with part or all of such costs. For any portion of such cost that remains in dispute, the Architect/Engineer will make an interim determination for purposes of monthly certification for payment for those costs. That determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a claim in accordance with Article 4.

7.3.12. When the Owner and Contractor agree with the determination made by the Architect/Engineer concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

7.4. MINOR CHANGES IN THE WORK

7.4.1. The Architect/Engineer will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

8. ARTICLE 8 – TIME

8.1. DEFINITIONS

8.1.1. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day shall be determined as the day following the current day of any event or notice starting a specified duration.

8.1.2. Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

8.1.3. The date of commencement of the Work is the date established in the NOTICE TO PROCEED AS ISSUED BY THE OWNER.

8.1.4. The date the Contractor reaches Substantial Completion is the date certified by the Architect/Engineer in accordance with Paragraph 9.8.

8.1.5. The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.
8.1.6. Liquidated Damages. The Owner may suffer loss if the project is not substantially complete on the date set forth in the contract documents. The Contractor and his surety shall be liable for and shall pay to the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay until the work is substantially complete. [Dollars in Alpha] AND NO/100 DOLLARS ($0.00).

8.1.7. The Contractor shall not be charged liquidated or actual damages when delay in completion of the Work is due to:

8.1.7.1. Any preference, priority or allocation order issued by the government;

8.1.7.2. Unforeseeable cause beyond the control and without the fault or negligence of the Contractor, such as acts of God or of the public enemy, fires, floods, epidemics, quarantine restrictions, freight embargoes, and unusually severe weather. All such occurrences resulting in delay must be documented and approved by Change Order;

8.1.7.3. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in 8.1.7.1 and 8.1.7.2 of this article.

8.1.7.4. The Contractor is completely obligated and responsible to provide written notice of each day of delay as provided for in Paragraph 4.3.

8.1.8. Contract Time. All work shall reach Substantial Completion (or Final Acceptance) by or within: [Duration] consecutive calendar days after the start date on the written NOTICE TO PROCEED.

8.2. PROGRESS AND COMPLETION

8.2.1. Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Contract the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

8.2.2. The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the date on the Notice to Proceed and in no case prior to the effective date of insurance required by Article 11 to be furnished by the Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance.

8.2.3. The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.2.4. If the Contractor falls behind the latest construction schedule by more than 14 calendar days through its own actions or inaction, neglect, inexperience, lack of oversight and management of the Work including that of any Subcontractors, written notice to the Owner and Architect/Engineer shall be provided within three (3) days with explanation of how the Contractor intends to get back on schedule. Response to getting back on schedule consists of providing a sufficient number of qualified workers and/or proper materials or an acceptably reorganized schedule to regain the lost time in a manner acceptable to the Owner.

8.2.5. Completion of the work within the stated time and/or by the date stated on the Notice to Proceed is of the essence of this Contract and failure to complete, without approved time extension, may be considered default of the Contract. At the time for completion as stated on the Notice to Proceed or as extended by approved change order, if the work is not substantially complete, the Owner may notify the Contractor and the Contractor’s surety company in writing of the recourse the Owner intends to take, within the Contract, to assess liquidated damages and/or cause the work to be completed.

8.3. DELAYS AND EXTENSIONS OF TIME

8.3.1. If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect/Engineer, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending mediation and arbitration, or by other causes which the Architect/Engineer determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect/Engineer may determine.
8.3.2. Claims relating to time shall be made in accordance with applicable provisions of Paragraph 4.3.

8.3.3. This Paragraph 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

9. PAYMENTS AND COMPLETION

9.1. CONTRACT SUM

9.1.1. The Contract Sum is stated in the Contract and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

9.2. SCHEDULE OF VALUES

9.2.1. Before the first Application for Payment, the Contractor shall submit to the Architect/Engineer a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect/Engineer may require. This schedule, unless objected to by the Architect/Engineer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

9.3. APPLICATIONS FOR PAYMENT

9.3.1. The Contractor shall submit to the Architect/Engineer an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be signed and supported by such data substantiating the Contractor's right to payment as the Owner or Architect/Engineer may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

9.3.2. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a Contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.

9.3.3. As provided in Subparagraph 7.3.11, such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives, or by interim determinations of the Architect/Engineer, but not yet included in Change Orders.

9.3.4. Applications for payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.

9.3.5. Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

9.3.6. The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

9.3.7. Until the work is complete, the Owner will pay 95% of the amount due the Contractor on account of progress payments.

9.3.7.1. If the Work and its progress are not in accordance with all or any part, piece, or portion of the Contract Documents, the Owner may, at its sole discretion and without claim by the Contractor,
increase the amount held as retainage to whatever level deemed necessary to effectuate performance and progress of the Work, for anticipated repairs, warranties or completion of the Work by the Contractor or through the letting of other contracts. The Contractor will not be entitled to additional costs, expenses, fees, time, and such like, in the event the Owner increases the amount held as retainage due to non-compliance and/or non-performance with all or any part, piece, or portion of the Contract Documents.

9.3.7.2. Prior to the first application for payment, the Contractor shall submit the following information on the appropriate forms:

9.3.7.2.1. Schedule of Values and Schedule of Amounts for Contract Payment (Form 100): This form shall contain a breakdown of the labor, material and other costs associated with the various portions of the work and shall be the basis for the progress payments to the Contractor.

9.3.7.2.2. Project/Progress Schedule: If no Schedule (or revised Schedule) is provided with each and every Periodic Estimates for Partial Payment, the Architect/Engineer and/or Owner may return the pay request, or hold it, and may choose not pay for any portion of the Work until the appropriate Schedule, indicating all changes, revisions and updates, is provided. No claim for additional costs or interests will be made by the Contractor or any subcontractor on account of holding or non-payment of the Periodic Estimate for Partial Payment request.

9.3.7.3. Progress Payments

9.3.7.3.1. Periodic Estimates for Partial Payment shall be on a form provided by the Owner (Form 101) and submitted to the Architect/Engineer for payment by the Owner. Payment shall be requested for the labor and material incorporated in the work to date and for materials suitably stored, less the aggregate of previous payments, the retainage, and the 1% gross receipts tax.

9.3.7.3.2. The Contractor, by submission of any partial pay request, certifies that every request for partial payment is correct, true and just in all respects and that payment or credit had not previously been received. The Contractor further warrants and certifies, by submission of any partial pay request, that all previous work for which payment has been received is free and clear of all liens, disputes, claims, security interests, encumbrances, or causes of action of any type or kind in favor of the Contractor, subcontractors, material suppliers or other persons or entities and does release the Owner from such.

9.3.7.3.3. Progress payments do not constitute official acceptance of any portion of the work or materials whether stored on or off-site.

9.3.7.3.4. In compliance with 15-50-206 MCA, the Contractor will have 1% of his gross receipts withheld by the Owner from all payments due. Each subcontractor who performs work greater than $5,000 shall have 1% of its gross receipts withheld by the Contractor. The Contractor shall notify the Department of Revenue on the department's prescribed forms.

9.3.7.4. The Contractor may submit obligations/securities in a form specified in 18-1-301 Montana Code Annotated (MCA) to be held by a Financial Institution in lieu of retainage by the Owner. The Owner will establish the amount that would otherwise be held as retainage. Should the Contractor choose to submit obligations/securities in lieu of retainage, the Owner will require the Financial Institution to execute the Owner’s “Account Agreement for Deposit of Obligations Other Than Retainage” (Form 120) prior to submission of any obligations/securities in accordance with 18-1-302 MCA. The Contractor must extend the opportunity to participate in all obligations/securities in lieu of retainage on a pro rata basis to all subcontractors involved in the project and shall be solely responsible for the management and administration of same. The Owner assumes no liability or responsibility from or to the Contractor or Subcontractors regarding the latter’s participation.

9.3.7.5. The Contractor shall maintain a monthly billing cycle.

9.4. CERTIFICATES FOR PAYMENT

9.4.1. The Architect/Engineer will, within seven days after receipt of the Contractor’s Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect/Engineer determines is properly due, or notify the Contractor and Owner in writing of the
Architect/Engineer's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1.

9.4.2. The issuance of a Certificate for Payment will constitute a representation by the Architect/Engineer to the Owner, based on the Architect/Engineer's evaluation of the Work and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect/Engineer's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect/Engineer. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect/Engineer has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or, (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

9.5. DECISIONS TO WITHHOLD CERTIFICATION

9.5.1. The Architect/Engineer may withhold or reject a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect/Engineer's opinion the representations to the Owner required by Subparagraph 9.4.2 cannot be made. If the Architect/Engineer is unable to certify payment in the amount of the Application, the Architect/Engineer will notify the Contractor and Owner as provided in Subparagraph 9.4.1. If the Contractor and Architect/Engineer cannot agree on a revised amount, the Architect/Engineer will promptly issue a Certificate for Payment for the amount for which the Architect/Engineer is able to make such representations to the Owner. The Architect/Engineer may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect/Engineer's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Subparagraph 3.3.4, because of:

9.5.1.1. defective Work not remedied;

9.5.1.2. third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;

9.5.1.3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

9.5.1.4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

9.5.1.5. damage to the Owner or another contractor;

9.5.1.6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or,

9.5.1.7. persistent failure to carry out the Work in accordance with the Contract Documents.

9.5.2. When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

9.5.3. Owner's Right to Refuse Payment: The Architect/Engineer's approval, or partial approval, of the Contractor's request for payment shall not preclude or prevent the Owner from exercising any of its remedies under this Contract. The Owner shall have right to refuse to make payment(s) to the Contractor due to:

9.5.3.1. the Contractor's failure to perform the Work in compliance with the Contract Documents;
9.5.3.2. the Contractor’s failure to correct any defective or damaged Work;

9.5.3.3. the Contractor’s failure to accurately represent the Work performed in the pay request;

9.5.3.4. the Contractor’s performance of its Work at a rate or in a manner that, in the Owner’s opinion, is likely to result in the Work, or any portion thereof, to be delayed;

9.5.3.5. the Contractor’s failure to use funds previously paid to it by the Owner to pay for the Contractor’s Work-related obligations including, but not limited to, subcontractors and suppliers on this Project;

9.5.3.6. claims made, or anticipated by the Owner to be made, against the Owner or its property;

9.5.3.7. inclusion in the pay request of any amounts in dispute or part of a claim;

9.5.3.8. Damage or loss caused by the Contractor, including its subcontractors and suppliers; or,

9.5.3.9. The Contractor’s failure or refusal to perform its obligations to the Owner.

9.6. PROGRESS PAYMENTS

9.6.1. After the Architect/Engineer has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents or the Owner may take any action the Owner deems necessary under Subparagraph 9.5.3.

9.6.2. The Contractor shall promptly pay each Subcontractor in accordance with Title 28, Chapter 2, Part 21, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor’s portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such Subcontractor’s portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

9.6.3. The Contractor is prohibited from holding higher amounts in retainage on any Subcontractor than the Owner is holding from the Contractor.

9.6.4. The Architect/Engineer will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect/Engineer and Owner on account of portions of the Work done by such Subcontractor.

9.6.5. Neither the Owner nor Architect/Engineer shall have an obligation to pay, or to see to the payment of, money to a Subcontractor except as may otherwise be required by law.

9.6.6. Payment to material suppliers shall be treated in a manner similar to that provided in Subparagraphs 9.6.2, 9.6.3, 9.6.4, and 9.6.5.

9.6.7. A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.6.8. Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

9.7. FAILURE OF PAYMENT

9.7.1. If the Owner does not approve payment to the Contractor within thirty-five (35) calendar days after the receipt of a certified Application for Payment, then the Contractor may, upon seven additional days’ written notice to the Owner and Architect/Engineer, suspend the Work until payment of the amount owing has been received. Nothing in the Subparagraph shall limit the Owner’s rights and options as provided in
Subparagraph 9.5.3. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

9.8. SUBSTANTIAL COMPLETION

9.8.1. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

9.8.2. When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect/Engineer a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

9.8.3. Upon receipt of the Contractor's list, the Architect/Engineer will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect/Engineer's Inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect/Engineer. In such case, the Contractor shall then submit a request for another inspection by the Architect/Engineer to determine Substantial Completion.

9.8.4. The Contractor shall ensure the project is substantially complete prior to requesting any inspection by the Architect/Engineer so that no more than one (1) inspection is necessary to determine Substantial Completion for all or any portion of the Work. If the Contractor does not perform adequate inspections to develop a comprehensive list as required in Subparagraph 9.8.2 and does not complete or correct such items upon discovery or notification, the Contractor shall be responsible and pay for the costs of the Architect/Engineer's additional inspections to determine Substantial Completion. Prior to the inspection, the Contractor shall complete the final clean-up of the Project site which, unless otherwise stated in the Contract Documents, shall consist of:

9.8.4.1. Removal of all debris and waste. All construction debris and waste shall be removed from the campus grounds. Use of the Owner trash containers will not be permitted.

9.8.4.2. Removal of all stains, smears, marks of any kind from surfaces including existing surfaces if said damage is the result of the work.

9.8.4.3. Removal of all temporary structures and barricades.

9.8.5. When the Work or designated portion thereof is substantially complete, the Architect/Engineer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion and which shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance. After issuance of the Certificate of Substantial Completion, the Contractor shall finish and complete all remaining items within thirty (30) calendar days of the date on the Certificate. The Architect/Engineer shall identify and fix the time for completion of specific items which may be excluded from the thirty (30) calendar day time limit. Failure to complete any items within the specified time frames may be deemed by the Owner as default of the contract on the part of the Contractor.

9.8.6. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety if there are claims or past payment issues, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

9.9. PARTIAL OCCUPANCY OR USE

9.9.1. The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is
consented to by the insurer and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect/Engineer as provided under Subparagraph 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect/Engineer.

9.9.2. Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect/Engineer shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.9.3. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.10. **FINAL COMPLETION AND FINAL PAYMENT**

9.10.1. Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect/Engineer will promptly make such inspection and, when the Architect/Engineer finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect/Engineer will approve the Contractor's final Certificate for Payment stating that to the best of the Architect/Engineer's knowledge, information and belief, and on the basis of the Architect/Engineer's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect/Engineer's signature on the Contractor's final Certificate for Payment will constitute a further representation that conditions listed in Subparagraph 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

9.10.2. Neither final payment nor any remaining retainage shall become due until the Contractor submits to the Architect/Engineer:

9.10.2.1. completed Affidavit on Behalf of Contractor (Form 106) that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied;

9.10.2.2. a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner;

9.10.2.3. a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents

9.10.2.4. Consent of Surety to make final payment (Form 103); and,

9.10.2.5. if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.

9.10.3. The Contractor and his surety accepts and assumes responsibility, liability, and costs for and agrees to defend and hold harmless the Owner for and against any and all actions as a result of the Owner making final payment.

9.10.4. By submitting any Application for Payment to the Architect/Engineer the Contractor and his surety certify and declare that all bills for materials, supplies, utilities and for all other things furnished or caused to be furnished by the Contractor and all Subcontractors and used in the execution of the Contract will be fully paid upon receipt of Final Payment and that there are no unpaid obligations, liens, claims, security interests,
encumbrances, liabilities and/or demands of State Agencies, subcontractors, suppliers, mechanics, laborers or any others resulting from or arising out of any work done, caused to be done or ordered to be done by the Contractor under the contract.

9.10.5. In consideration of the prior payments and the final payment made and all payments made for authorized changes, the Contractor releases and forever discharges the Owner from any and all obligations, liens, claims, security interests, encumbrances and/or liabilities arising by virtue of the contract and authorized changes between the parties, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the Owner, arising out of or in any way relating to the contract and authorized changes.

9.10.6. The date of Final Payment by the Owner shall constitute Final Acceptance of the Work. The determining date for the expiration of the warranty period shall be as specified in Paragraphs 3.5 and 12.2.2.

9.10.7. If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect/Engineer so confirms, the Owner shall, upon application by the Contractor and certification by the Architect/Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect/Engineer prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

9.10.8. The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

9.10.8.1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

9.10.8.2. failure of the Work to comply with the requirements of the Contract Documents; or,

9.10.8.3. terms of special warranties required by the Contract Documents.

9.10.9. Acceptance of final payment by the Contractor, a Subcontractor, or material supplier, shall constitute a waiver of any and all obligations, liens, claims, security interests, encumbrances and/or liabilities against the Owner except those previously made in writing per the requirements of Paragraph 4.3 and as yet unsettled at the time of submission of the final Application for Payment.

9.10.10. The Owner’s issuance of Final Payment does not constitute a waiver or release of any kind regarding any past, current, or future claim the Owner may have against the Contractor and/or the surety.

10. ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY

10.1. SAFETY

10.1.1. Importance of Safety. The Contractor and all Subcontractors (at any tier or level) recognize that safety is paramount at all times. The Contractor shall perform the work in a safe manner with the highest regard for safety of its employees and all other individuals and property at the work site. Contractor shall maintain its tools, equipment, and vehicles in a safe operating condition and take all other actions necessary to provide a safe working environment for performance of work required under this Contract. The Contractor is solely responsible for the means, methods, techniques, sequences and procedures for coordinating and constructing the Work, including all site safety, safety precautions, safety programs, and safety compliance with OSHA and all other governing bodies.

10.1.2. Particular Safeguards. (a). The Contractor shall erect and maintain, as required by Paragraphs 10.1.1 and 10.1.3, safeguards for safety and protection, including posting danger signs and other warnings against hazards, installing suitable barriers and lighting, promulgating safety regulations, and providing notification to all parties who may be impacted by the Contractor’s operations. (b) When use or storage of explosives or other Hazardous Materials/Substances (defined below) or equipment are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly
qualified personnel. (c) The Contractor shall not encumber or load or permit any part of the construction site to be encumbered or loaded so as to endanger the safety of any person(s).

10.1.3. **Compliance with Safety Laws.** Contractor represents and warrants to Owner that it knows and understands all federal, state and local safety statutes, rules, and regulations (Laws) related to the work under this Contract. Contractor shall comply with these Laws. Contractor shall keep all material data safety sheets on site and available at all times.

10.1.4. **Remedy property damage.** The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor of any tier or level, or anyone employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.18.

10.1.5. **Designation of Safety Representative.** Unless the Contractor designates, in writing to the Owner and the Architect/Engineer, another responsible member of the Contractor's organization as the Safety Representative, the Contractor's superintendent is the Safety Representative. The Safety Representative is defined as that member of the Contractor's organization responsible for all safety under this Contract.

10.1.6. **Release/Indemnity of Owner and Architect/Engineer.** The Contractor agrees that the Owner and Architect/Engineer are not responsible for safety at the work site and releases them from all obligations and liability regarding safety at the work site. The Contractor shall indemnify and defend the Owner and the Architect/Engineer against and from all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses (including but not limited to court costs and reasonable attorney fees), arising from injuries and death to any persons and damage to real and personal property arising from, in connection with, or incidental to Contractor's safety responsibilities under this Contract.

10.2. **HAZARDOUS MATERIALS/SUBSTANCES**

10.2.1. “Hazardous Materials/Substances” means any substance: (a) the presence of which requires investigation, or remediation under any federal, state or local statute, rule, regulation, ordinance, order, policy or common law; (b) that is or becomes defined as “hazardous waste,” “hazardous substance,” pollutant, or contaminant under any federal, state or local statute, rule, regulation, or ordinance or amendments thereto; (c) that is toxic, explosive, corrosive flammable, or otherwise hazardous and is or becomes regulated by any government authority, agency, board, commission or instrumentality of the United States, the state of Montana or any political subdivision thereof; (d) gasoline, diesel fuel or other petroleum hydrocarbons; (e) contains contains polychlorinated biphenyls (PCBs) or asbestos; or (f) the presence of which causes or threatens to cause a nuisance or trespass on the work site or adjacent property.

10.2.2. The Contractor is solely responsible for all compliance with all regulations, requirements, and procedures governing Hazardous Materials/Substances at the Work Site or that Contractor brings on the site. The Contractor is solely responsible for remediation, costs, damages, loss, and/or expenses for all Hazardous Materials/Substances brought to the site.

10.2.3. If the Contractor encounters Hazardous Materials/Substances during the course of the Work, whether or not identified in the Contract Documents, Work, the Contractor agrees that:

10.2.3.1. Encountering any Hazardous Materials/Substances during performance of the Work does not necessarily mean a change in conditions has occurred nor is it evidence that the Contractor is due additional Contract Time or an increase in the Contract Sum. If encountering Hazardous Materials/Substances is determined to be a change in conditions to the Contract Documents, Paragraph 4.3 and Article 7 apply in determining any additional compensation or extension of time claimed by the Contractor.

10.2.3.2. The Contractor is solely responsible for securing the Work in accordance with this Article 10 involving any Hazardous Materials/Substances against unlawful, unregulated, or improper intrusion, disturbance, or removal. The Contractor shall implement protections and take protective actions throughout the performance of the Work to prevent exposure to workers, occupants, and contamination of the site or area.

10.2.3.3. If the Contractor is unable to or fails to properly secure the Work against unlawful, unregulated, or improper intrusion, disturbance, or removal of Hazardous Materials/Substances, the Contractor shall
immediately implement protections and take protective actions, up to and including stopping Work in
the area or on the item affected, to prevent exposure to workers, occupants, and contamination of the
site or area. The Contractor shall immediately notify the Owner and Architect in writing giving details
of the failure and the corrective actions taken. If the condition is an emergency and notice cannot be
provided in writing, then Contractor shall orally and immediately notify the Owner and Architect/Engineer of the condition followed by a full written explanation. In an emergency affecting
safety of persons or property, the Contractor shall act, at the Contractor’s discretion, to prevent
threatened damage, injury or loss.

10.2.3.4. If the Contractor notifies the Owner and takes precautions in accordance with this Article 10 upon
encountering materials/substances suspected of containing asbestos or polychlorinated biphenyls that
are unidentified in the Contract Documents, the Owner shall verify if the unidentified material or
substance contains asbestos or polychlorinated biphenyls and shall arrange for the removal or other
measures as necessary to allow the Contractor to proceed with the Work. The Contract Time may be
extended as appropriate if the Work affected is on the critical path and the Contract Sum shall be
increased in the amount of the Contractor’s reasonable additional costs as provided in Article 7.
Should the Contractor fail to notify the Owner upon encountering asbestos, polychlorinated biphenyls,
or materials/substances suspected of containing asbestos or polychlorinated biphenyls, that are
unidentified in the Contract Documents, the Contractor is solely responsible for all mitigation in
accordance with Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.

10.2.4. The Contractor shall indemnify, hold harmless, and defend the Owner from and against all claims,
liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses, including but
not limited to court costs and reasonable attorneys’ fees, arising from, in connection with, or incidental to the
Contractor’s handling, disposal, encountering, or release of Hazardous Materials/Substances.

10.3. UTILITIES

10.3.1. Underground Utilities: Buried utilities, including, but not limited to, electricity, gas, steam, air, water,
telephone, sewer, irrigation, broadband coaxial computer cable, and fiber optic cables are very vulnerable
and damage could result in loss of service. The telephone, broadband and fiber optic cables are especially
sensitive and the slightest damage to these components will result in disruption of the operations of the
park.

10.3.2. "One Call" must be notified by phone and in writing at least 72 hours (3 business days) prior to digging to
arrange and assist in the location of buried utilities in the field. (Dial 811). The Contractor shall mark the
boundary of the work area. The boundary area shall be indicated with white paint and white flags. In winter,
pink paint and flags will be accepted.

10.3.3. After buried utilities have been located, the Contractor shall be responsible for any utilities damaged while
digging. Such responsibility shall include all necessary care including hand digging. Contractor's
responsibility shall also include maintaining markings after initial locate. The area for such responsibility,
unles otherwise indicated, shall extend 24 inches to either side of the marked center line of a buried utility
line. In cases of multiple or overlapping utilities or inconclusive electronic locating signals, MSU Project
Manager may specifically indicate a wider area for Contractor's responsibility.

10.3.4. The Contractor's responsibility shall include repair or replacement of damaged utilities. In the event of
damage to the 15 KV electrical distribution system, the broadband or fiber optic cables, repair will consist of
replacement from termination to termination. Facilities Services and the MSU Information Technology
Center will verify repair and recertification. The Contractor will also be responsible for all costs associated
with reterminations and recertification.

10.3.5. Any buried utilities exposed by the operations of the Contractor shall be marked on the plans and
adequately protected by the Contractor. If any buried utilities not located are exposed, the Contractor shall
immediately contact Facilities Services at the numbers above. If, after exposing an unlocated buried utility,
the Contractor continues digging without notifying Facilities Services and further damages the utility, the
Contractor will be responsible.

10.3.6. Damage to irrigation systems during seasons of no irrigation that are not immediately and adequately
repaired and tested will require the Contractor to return when the system is in service to complete the repair.
10.3.7. In the event of a planned interruption of any existing utility service, the Contractor shall make arrangements with Facilities Services at least 72 hours (3 business days) in advance. Shutdowns of the broadband or fiber optic cables will normally require 5 working days notice to Facilities Services and the Information Technology Center. The Contractor shall bear all costs associated with the interruptions and restorations of service.

11. ARTICLE 11 - INSURANCE AND BONDS

11.1. CONTRACTOR’S LIABILITY INSURANCE

11.1.1. The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the State of Montana with a rating no less than “A-”, such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor’s operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

11.1.1.1. claims under workers’ compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;
11.1.1.2. claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
11.1.1.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
11.1.1.4. claims for damages insured by usual personal injury liability coverage;
11.1.1.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting there from;
11.1.1.6. claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
11.1.1.7. claims for bodily injury or property damage arising out of completed operations; and,
11.1.1.8. claims involving contractual liability insurance applicable to the Contractor’s obligations under Paragraph 3.18.

11.1.2. The insurance required by Subparagraph 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until termination of any coverage required to be maintained after final payment.

11.1.3. Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies required by this Paragraph 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days’ prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Subparagraph 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor’s information and belief.

11.1.4. At the request of the Owner, the Contractor shall provide copies of all insurance policies to the Owner.

11.2. INSURANCE, GENERAL REQUIREMENTS

11.2.1. The Contractor shall maintain for the duration of the contract, at its cost and expense, insurance against claims for injuries to persons or damages to property, including contractual liability, which may arise from or in connection with the performance of the Work by the Contractor, its agents, employees, representatives,
assigns, or subcontractors. The Contractor is responsible for all deductibles regardless of policy or level of coverage. The Owner reserves the right to demand, and the Contractor agrees to provide, copies of any and all policies at any time.

11.2.2. Hold Harmless and Indemnification: The Contractor shall protect, defend, and save the state, its elected and appointed officials, agents, and employees, while acting within the scope of their duties as such, harmless from and against all claims, liabilities, demands, causes of action, and judgments whatsoever (including the cost of defense and reasonable attorney fees) arising in favor of or asserted by third parties on account of damage to property, personal injury, or death which injury, death, or damage, arises out of services performed or omissions of services or in any way results from the negligent acts or omissions of the Contractor, its agents, agents, or subcontractors.

11.2.3. Contractor's Insurance: insurance required under all sections herein shall be in effect for the duration of the contract that extends through the warranty period. Insurance required herein shall be provided by insurance policies issued only by insurance companies currently authorized to do business in the state of Montana. No Contractor or Sub-contractor shall commence any Work under this contract until all required insurance has been obtained. During the term of this contract, the Contractor shall, not less than thirty days prior to the expiration date of any policy for which a certificate of insurance is required, deliver to the Owner a certificate of insurance with respect to the renewal insurance policy. The Contractor shall furnish one copy of insurance certificates of insurance herein required, which shall specifically set forth evidence of all coverage required by these contract documents and which shall be signed by authorized representatives of the insurance company or companies evidencing that insurance as required herein is in force and will not be canceled, limited or restricted without thirty days' written notice by certified mail to the contractor and the Owner. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. Additionally, all certificates shall include the project name and A/E project number.

11.2.4. Certificates of Insurance and Endorsements. All certificates of insurance and the additional insured endorsements are to be received by the state prior to issuance of the Notice to Proceed. The contractor is responsible to ensure that all policies and coverages contain the necessary endorsements for the State being listed as an additional insured. The state reserves the right to require complete copies of all insurance policies at any time to verify coverage. The contractor shall notify the state within 30 days of any material change in coverage.

11.3. WORKERS' COMPENSATION INSURANCE

11.3.1. The Contractor shall carry Workers' Compensation Insurance. Such Workers' Compensation Insurance shall protect the Contractor from claims made by his own employees, the employees of any Sub-contractor, and also claims made by anyone directly or indirectly employed by the Contractor or Sub-contractor. The Contractor shall require each Sub-contractor similarly to provide Workers' Compensation Insurance.

11.4. COMMERCIAL GENERAL LIABILITY INSURANCE

11.4.1. Each Contractor shall carry per occurrence coverage Commercial General Liability Insurance including coverage for premises; operations; independent contractor's protective; products and completed operations; products and materials stored off-site; broad form property damage and comprehensive automobile liability insurance with not less than the following limits of liability:

11.4.1.1. $5,000,000 per occurrence; aggregate limit of $10,000,000;

11.4.1.2. The Commercial General and Automobile Liability Insurance shall provide coverage for both bodily injury, including accidental death, sickness, disease, occupational sickness or disease, personal injury liability coverage and property damage which may arise out of the work under this contract, or operations incidental thereto, whether such work and operations be by the Contractor or by any Subcontractor or by anyone directly or indirectly employed by the Contractor or by a Sub-contractor, or by anyone for whose acts any of them may be liable. The Contractor shall maintain the liability insurance required herein for a period of not less than one year after final payment or anytime the Contractor goes on to the location of the project.

11.4.1.3. The Contractor's liability insurance policies shall list the STATE OF MONTANA as an additional insured. The STATE OF MONTANA includes its officers, elected and appointed officials, employees
and volunteers and political subdivisions thereof. Should the Contractor not be able to list the state as an additional insured, the Contractor shall purchase a per occurrence Owner’s/Contractor’s Protective Policy (OCP) with the STATE OF MONTANA as the insured party in the same occurrence and aggregate limits as that indicated above for the Contractor's Commercial General Liability Policy.

11.4.1.4. Property damage liability insurance shall be written without any exclusion for injury to or destruction of any building, structure, wires, conduits, pipes, or other property above or below the surface of the ground arising out of the blasting, explosion, pile driving, excavation, filling, grading or from the moving, shoring, underpinning, raising, or demolition of any building or structure or structural support thereof.

11.4.1.5. The Contractor’s insurance coverage shall be PRIMARY insurance as respects the State, its officers, elected and appointed officials, employees and volunteers. Any insurance or self-insurance maintained by the state, its officers, elected and appointed officials, employees and volunteers shall be excess of the Contractor’s insurance and shall not contribute to it. No waivers of subrogation or endorsements limiting, transferring, or otherwise indemnifying liable or responsible parties of the Contractor or any subcontractor will be accepted.

11.5. PROPERTY INSURANCE (ALL RISK)

11.5.1. New Construction (for projects involving new construction): At its sole cost and expense, the contractor shall keep the building and all other improvements on the premises insured throughout the term of the agreement against the following hazards:

11.5.1.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map, http://rmtd.mt.gov/aboutus/publications/files/NEHRP.pdf) in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire insurance policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.

11.5.1.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.

11.5.1.3. Loss or damage by explosion of steam boilers, pressure vessels, and oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.

11.5.2. Building Renovation (for projects involving building renovation or remodeling)

11.5.2.1. The contractor shall purchase and maintain Builder’s Risk/Installation insurance on a “special causes of loss” form (so called “all risk”) for the cost of the work and any subsequent modifications and change orders. The contractor is not responsible for insuring the existing structure for Builder’s Risk/Installation insurance.

11.5.2.2. At its sole cost and expense, the contractor shall insure all property construction on the premises throughout the term of the agreement against the following hazards:

11.5.2.2.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map at http://rmtd.mt.gov/aboutus/publications/files/NEHRP.pdf) in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire insurance policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.

11.5.2.2.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.

11.5.2.2.3. Loss or damage by explosion of steam boilers, pressure vessels, oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.

11.6. ASBESTOS ABATEMENT INSURANCE

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11.6.1. If Asbestos Abatement is identified as part of the Work under this contract, the Contractor or any subcontractor involved in asbestos abatement shall purchase and maintain **Asbestos Liability Insurance** for coverage of bodily injury, sickness, disease, death, damages, claims, errors or omissions regarding the asbestos portion of the work **in addition to** the CGL Insurance by reason of any negligence in part or in whole, error or omission committed or alleged to have been committed by the Contractor or anyone for whom the Contractor is legally liable.

11.6.2. Such insurance shall be in “per occurrence” form and shall clearly state on the certificate that asbestos work is included in the following limits:

11.6.2.1. **$1,000,000 per occurrence; aggregate limit of $2,000,000.**

11.6.3. Asbestos Liability Insurance as carried by the asbestos abatement subcontractor in these limits in lieu of the Contractor’s coverage is acceptable provided the Contractor and the State of Montana are named as additional insureds and that the abatement subcontractor’s insurance is PRIMARY as respects both the Owner and the Contractor. If the Contractor or any other subcontractor encounters asbestos, all operations shall be suspended until abatement with the associated air monitoring clearances are accomplished. The certificate of coverage shall be provided by the asbestos abatement subcontractor to both the Contractor and the Owner.

11.7. **PERFORMANCE BOND AND LABOR & MATERIAL PAYMENT BOND (BOTH ARE REQUIRED ON THIS PROJECT)**

11.7.1. The Contract shall furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201 MCA). The Contractor shall also furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201MCA). The bonds shall be executed on forms furnished by the Owner and no other forms or endorsements will be acceptable. The bonds shall be signed in compliance with state statutes (33-17-1111 MCA). Bonds shall be secured from a state licensed bonding company. Power of Attorney is required with each bond. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney:

11.7.1.1. one original copy shall be furnished with each set of bonds.

11.7.1.2. Others furnished with a set of bonds may be copies of that original.

11.7.2. The Owner reserves the right at any time during the performance of Work to require bonding of Subcontractors provided by the General Contractor. Should this occur, the Owner will cover the direct cost. This shall not be construed as to in any way affect the relationship between the General Contractor and his Subcontractors.

11.7.3. Surety must have an endorsement stating that their guarantee of Contractor's performance automatically covers the additional contract time added to a Contractor's contract by Change Order.

11.7.4. A change in the Contractor's organization shall not constitute grounds for Surety to claim a discharge of their liability and requires an endorsement from Surety so stating.

11.7.5. The Contractor is required to notify Surety of increase in contract amount resulting from Change Orders within 48 hours of submitting an application for Change Order and submit a copy of Surety's written acknowledgment and consent to Owner before Change Order can be approved. A fax with hard copy to follow is acceptable. If hard copy is not received by Owner before Application for Payment on any portion or all of said Change Order, it will not be accepted by Owner for payment.

11.7.6. The Surety must take action within 30 days of notice of default on the part of the Contractor or of any claim on bonds made by the Owner or any Subcontractor or supplier.

12. **ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK**

12.1. **UNCOVERING OF WORK**
12.1.1. If a portion of the Work is covered contrary to the Architect/Engineer's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect/Engineer, be uncovered for the Architect/Engineer's examination and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2. If a portion of the Work has been covered which the Architect/Engineer has not specifically requested to examine prior to it being covered, the Architect/Engineer may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

12.2. **CORRECTION OF WORK**

12.2.1. **BEFORE OR AFTER SUBSTANTIAL COMPLETION**

12.2.1.1. The Contractor shall promptly correct Work that fails to conform to the requirements of the Contract Documents or that is rejected by the Architect/Engineer, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect/Engineer's services and expenses made necessary thereby, shall be at the Contractor's expense. The Contractor is responsible to discover and correct all defective work and shall not rely upon the Architect/Engineer's or Owner's observations.

12.2.1.2. Rejection and Correction of Work in Progress. During the course of the Work, the Contractor shall inspect and promptly reject any Work that:

12.2.1.2.1. does not conform to the Construction Documents; or,

12.2.1.2.2. does not comply with any applicable law, statute, building code, rule or regulation of any governmental, public and quasi-public authorities, and agencies having jurisdiction over the Project.

12.2.1.3. The Contractor shall promptly correct or require the correction of all rejected Work, whether observed before or after Substantial Completion. The Contractor shall bear all costs of correcting such Work, including additional testing, inspections, and compensation for all services and expenses necessitated by such corrective action.

12.2.2. **AFTER SUBSTANTIAL COMPLETION AND AFTER FINAL ACCEPTANCE**

12.2.2.1. In addition to the Contractor's obligations under Paragraph 3.5, if, within one year after the date of Final Acceptance of the Work or designated portion thereof or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect/Engineer, the Owner may correct it in accordance with Paragraph 2.3.

12.2.2.1.1. The Contractor shall remedy any and all deficiencies due to faulty materials or workmanship and pay for any damage to other work resulting there from, which shall appear within the period of Substantial Completion through one (1) year from the date of Final Acceptance in accordance with the terms and conditions of the Contract and with any special guarantees or warranties provided in the Contract Documents. The Owner shall give notice of observed deficiencies with reasonable promptness. All questions, claims or disputes arising under this Article shall be decided by the Architect/Engineer. All manufacturer, product and supplier warranties are in addition to this Contractor warranty.
12.2.2.1.2. The Contractor shall respond within seven (7) days after notice of observed deficiencies has been given and he shall proceed to immediately remedy these deficiencies.

12.2.2.1.3. Should the Contractor fail to respond to the notice or not remedy those deficiencies; the Owner shall have this work corrected at the expense of the Contractor.

12.2.2.1.4. Latent defects shall be in addition to those identified above and shall be the responsibility of the Contractor per the statute of limitations for a written contract (27-2-208 MCA) starting from the date of Final Acceptance.

12.2.2. The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work.

12.2.3. The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Paragraph 12.2.

12.2.3. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

12.2.4. The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.5. Nothing contained in this Paragraph 12.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the one-year period for correction of Work as described in Subparagraph 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

12.3. ACCEPTANCE OF NONCONFORMING WORK

12.3.1. If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

13. ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1. GOVERNING LAW

13.1.1. The Contract shall be governed by the laws of the State of Montana and venue for all legal proceedings shall be the First Judicial District, Lewis & Clark County.

13.2. SUCCESSORS AND ASSIGNS

13.2.1. The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempt to make such assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

13.3. WRITTEN NOTICE
13.3.1. Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

13.4. **RIGHTS AND REMEDIES**

13.4.1. Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

13.4.2. No action or failure to act by the Owner, Architect/Engineer or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.5. **TESTS AND INSPECTIONS**

13.5.1. Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect/Engineer timely notice of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. The Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.

13.5.2. If the Architect/Engineer, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Subparagraph 13.5.1, the Architect/Engineer will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect/Engineer of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. Such costs, except as provided in Subparagraph 13.5.3 shall be at the Owner's expense.

13.5.3. If such procedures for testing, inspection or approval under Subparagraphs 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect/Engineer's services and expenses shall be at the Contractor's expense.

13.5.4. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect/Engineer.

13.5.5. If the Architect/Engineer is to observe tests, inspections or approvals required by the Contract Documents, the Architect/Engineer will do so promptly and, where practicable, at the normal place of testing.

13.5.6. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.6. **INTEREST**

13.6.1. Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

13.7. **COMMENCEMENT OF STATUTORY LIMITATION PERIOD**

13.7.1. As between the Owner and Contractor:

13.7.1.1. **Before Substantial Completion.** As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged
cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;

13.7.1.2. Between Substantial Completion and Final Certificate for Payment. As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and,

13.7.1.3. After Final Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Paragraph 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

13.8. PAYROLL AND BASIC RECORDS

13.8.1. Payrolls and basic records pertaining to the project shall be kept on a generally recognized accounting basis and shall be available to the Owner, Legislative Auditor, the Legislative Fiscal Analyst or his authorized representative at mutually convenient times. Accounting records shall be kept by the Contractor for a period of three years after the date of the Owner’s Final Acceptance of the Project.

14. ARTICLE 14 – TERMINATION OR SUSPENSION OF THE CONTRACT

14.1. TERMINATION BY THE CONTRACTOR

14.1.1. The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

14.1.1.1. issuance of an order of a court or other public authority having jurisdiction which requires all Work to be stopped; or,

14.1.1.2. an act of government, such as a declaration of national emergency which requires all Work to be stopped.

14.1.2. The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Paragraph 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

14.1.3. If one of the reasons described in Subparagraph 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days’ written notice to the Owner and Architect/Engineer, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit but not damages.

14.1.4. If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner’s obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days’ written notice to the Owner and the Architect/Engineer, terminate the Contract and recover from the Owner as provided in Subparagraph 14.1.3.

14.2. TERMINATION BY THE OWNER FOR CAUSE

14.2.1. The Owner may terminate the Contract if the Contractor:
14.2.1.1. persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

14.2.1.2. fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

14.2.1.3. persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or,

14.2.1.4. otherwise is guilty of any breach of a provision of the Contract Documents.

14.2.2. When any of the above reasons exist, the Owner, upon certification by the Architect/Engineer that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

14.2.2.1. take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

14.2.2.2. accept assignment of subcontracts pursuant to Paragraph 5.4; and,

14.2.2.3. finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

14.2.3. When the Owner terminates the Contract for one of the reasons stated in Subparagraph 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

14.2.4. If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect/Engineer's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect/Engineer, upon application, and this obligation for payment shall survive termination of the Contract.

14.3. **SUSPENSION BY THE OWNER FOR CONVENIENCE**

14.3.1. The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.3.2. The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Subparagraph 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:

14.3.2.1. that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or,

14.3.2.2. that an equitable adjustment is made or denied under another provision of the Contract.

14.4. **TERMINATION BY THE OWNER FOR CONVENIENCE**

14.4.1. The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

14.4.2. Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall:

14.4.2.1. cease operations as directed by the Owner in the notice;

14.4.2.2. take actions necessary, or that the Owner may direct, for the protection and preservation of the Work, and;
14.4.2.3. except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

14.4.3. In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed. The Contractor shall provide a full and complete itemized accounting of all costs.

14.4.4. In the event of termination or cancellation of any or all pre-construction services and/or decision not pursue a GMP Amendment/Contract, the Contractor shall not be due any costs, or overhead, or profit on any portion of the Work.

15. EQUAL OPPORTUNITY

15.1. The Contractor and all Sub-contractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin or age and shall comply with all Federal and State laws concerning fair labor standards and hiring practices. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, color, sex, national origin or age. Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

15.2. The Contractor and all Sub-contractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex, national origin or age.

16. [END OF GENERAL CONDITIONS]
MONTANA
PREVAILING WAGE RATES FOR BUILDING CONSTRUCTION SERVICES 2015

Effective: January 2, 2015

Steve Bullock, Governor
State of Montana

Pam Bucy, Commissioner
Department of Labor and Industry

To obtain copies of prevailing wage rate schedules, or for information relating to public works projects and payment of prevailing wage rates, visit ERD at www.mtwagehourbopa.com or contact:

Employment Relations Division
Montana Department of Labor and Industry
P. O. Box 201503
Helena, MT 59620-1503
Phone 406-444-5600
TDD 406-444-5549

The Labor Standards Bureau welcomes questions, comments and suggestions from the public. In addition, we'll do our best to provide information in an accessible format, upon request, in compliance with the Americans with Disabilities Act.

MONTANA PREVAILING WAGE REQUIREMENTS

The Commissioner of the Department of Labor and Industry, in accordance with Sections 18-2-401 and 18-2-402 of the Montana Code Annotated (MCA), has determined the standard prevailing rate of wages for the occupations listed in this publication.

The wages specified herein control the prevailing rate of wages for the purposes of 18-2-401, et seq., MCA. It is required that each employer pay (as a minimum) the rate of wages, including fringe benefits, travel allowance, zone pay and per diem applicable to the district in which the work is being performed as provided in the attached wage determinations.

All Montana Prevailing Wage Rates are available on the internet at www.mtwagehourbopa.com or by contacting the Labor Standards Bureau at (406) 444-5600 or TDD (406) 444-5549.

In addition, this publication provides general information concerning compliance with Montana’s Prevailing Wage Law and the payment of prevailing wages. For detailed compliance information relating to public works contracts and payment of prevailing wage rates, please consult the regulations on the internet at www.mtwagehourbopa.com or contact the Labor Standards Bureau at (406) 444-5600 or TDD (406) 444-5549.

PAM BUCY
Commissioner
Department of Labor and Industry
State of Montana
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A. Date of Publication
The rate schedule was published with the Secretary of State on December 24, 2014. It is for use in bid solicitations first made on or after January 2, 2015.

B. Definition of Building Construction
For the purposes of Prevailing Wage, the Commissioner of Labor and Industry has determined that building construction occupations are defined to be those performed by a person engaged in a recognized trade or craft, or any skilled, semi-skilled, or unskilled manual labor related to the construction, alteration, or repair of a public building or facility, and does not include engineering, superintendence, management, office or clerical work.

The Administrative Rules of Montana (ARM) 24.17.501(2) – 2(a), Public Works Contracts for Construction Services Subject to Prevailing Wage Rates, states: “Building construction projects generally are the constructions of sheltered enclosures with walk-in access for housing persons, machinery, equipment, or supplies. It includes all construction of such structures, incidental installation of utilities and equipment, both above and below grade level, as well as incidental grading, utilities and paving.

Examples of building construction include, but are not limited to, alterations and additions to buildings, apartment buildings (5 stories and above), arenas (closed), auditoriums, automobile parking garages, banks and financial buildings, barracks, churches, city halls, civic centers, commercial buildings, court houses, detention facilities, dormitories, farm buildings, fire stations, hospitals, hotels, industrial buildings, institutional buildings, libraries, mausoleums, motels, museums, nursing and convalescent facilities, office buildings, out-patient clinics, passenger and freight terminal buildings, police stations, post offices, power plants, prefabricated buildings, remodeling buildings, renovating buildings, repairing buildings, restaurants, schools, service stations, shopping centers, stores, subway stations, theaters, warehouses, water and sewage treatment plants (buildings only), etc.”

C. Definition of Public Works Contract
Section 18-2-401(11)(a), MCA defines “public works contract” as “…a contract for construction services let by the state, county, municipality, school district, or political subdivision or for nonconstruction services let by the state, county, municipality, or political subdivision in which the total cost of the contract is in excess of $25,000…”

D. Prevailing Wage Schedule
This publication covers only Building Construction occupations and rates. These rates will remain in effect until superseded by a more current publication. Current prevailing wage rate schedules for Heavy Construction, Highway Construction, and Nonconstruction Services occupations can be found on the internet at www.mtwagehourbopa.com or by contacting the Labor Standards Bureau at (406) 444-5600 or TDD (406) 444-5549.

E. Rates to Use for Projects
Rates to be used on a public works project are those that are in effect at the time the project and bid specifications are advertised.

F. Wage Rate Adjustments for Multiyear Contracts
Section 18-2-417, MCA states:

“(1) Any public works contract that by the terms of the original contract calls for more than 30 months to fully perform must include a provision to adjust, as provided in subsection (2), the standard prevailing rate of wages to be paid to the workers performing the contract.

(2) The standard prevailing rate of wages paid to workers under a contract subject to this section must be adjusted 12 months after the date of the award of the public works contract. The amount of the adjustment must be a 3% increase. The adjustment must be made and applied every 12 months for the term of the contract.

(3) Any increase in the standard rate of prevailing wages for workers under this section is the sole responsibility of the contractor and any subcontractors and not the contracting agency.”
G. Fringe Benefits
Section 18-2-412, MCA states:

“(1) To fulfill the obligation...a contractor or subcontractor may:

(a) pay the amount of fringe benefits and the basic hourly rate of pay that is part of the standard prevailing rate of wages directly to the worker or employee in cash;

(b) make an irrevocable contribution to a trustee or a third person pursuant to a fringe benefit fund, plan, or program that meets the requirements of the Employee Retirement Income Security Act of 1974 or that is a bona fide program approved by the U. S. department of labor; or

(c) make payments using any combination of methods set forth in subsections (1)(a) and (1)(b) so that the aggregate of payments and contributions is not less than the standard prevailing rate of wages, including fringe benefits and travel allowances, applicable to the district for the particular type of work being performed.

(2) The fringe benefit fund, plan, or program described in subsection (1)(b) must provide benefits to workers or employees for health care, pensions on retirement or death, life insurance, disability and sickness insurance, or bona fide programs that meet the requirements of the Employee Retirement Income Security Act of 1974 or that are approved by the U. S. department of labor.”

Fringe benefits are paid for all hours worked (straight time and overtime hours). However, fringe benefits are not to be considered a part of the hourly rate of pay for calculating overtime, unless there is a collectively bargained agreement in effect that specifies otherwise.

H. Prevailing Wage Districts
Montana counties are aggregated into 4 districts for the purpose of prevailing wage. The prevailing wage districts are composed of the following counties:

![Montana Prevailing Wage Districts Map]
I. Dispatch City
Dispatch City is the courthouse in the city from the following list which is closest to the center of the job: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula.

J. Zone Pay
Zone pay is not travel pay. It is an amount added to the base pay, the combined sum then becomes the new base wage rate to be paid for all hours worked on the project. Zone pay shall be determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city to the center of the job.

K. Computing Travel Benefits
Travel pay, also referred to as travel allowance, shall be paid for travel both to and from the job site, except those with special provisions listed under the classification. The rate is determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city or the employee's home, whichever is closer, to the center of the job.

L. Per Diem
Per Diem typically covers the costs associated with board and lodging expenses. Per diem is paid when an employee is required to work at a location outside the daily commuting distance and is required to stay overnight or longer.

M. Apprentices
Wage rates for apprentices registered in approved federal or state apprenticeship programs are contained in those programs. Additionally, section 18-2-416(2), MCA states, “...The full amount of any applicable fringe benefits must be paid to the apprentice while the apprentice is working on the public works contract.” Apprentices not registered in approved federal or state apprenticeship programs will be paid the appropriate journey level prevailing wage rate when working on a public works contract.

N. Posting Notice of Prevailing Wages
Section 18-2-406, MCA provides that contractors, subcontractors and employers who are “...performing work or providing construction services under public works contracts, as provided in this part, shall post in a prominent and accessible site on the project or staging area, not later than the first day of work and continuing for the entire duration of the project, a legible statement of all wages and fringe benefits to be paid to the employees.”

O. Employment Preference
Sections 18-2-403 and 18-2-409, MCA requires contractors to give preference to the employment of bona fide Montana residents in the performance of work on public works contracts.

P. Building Construction Occupations Website
You can find definitions for these occupations on the following Bureau of Labor Statistics website:
http://www.bls.gov/oes/current/oes_stru.htm

Q. Welder Rates
Welders receive the rate prescribed for the craft performing an operation to which welding is incidental.

R. Foreman Rates
Rates are no longer set for foremen. However, if a foreman performs journey level work, the foreman must be paid at least the journey level rate.
# WAGE RATES

## BOILERMAKERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
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<tr>
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<td>$29.45</td>
</tr>
<tr>
<td>District 4</td>
<td>$30.00</td>
<td>$29.45</td>
</tr>
</tbody>
</table>

**Travel:**

- **All Districts**
  - 0-120 mi. free zone
  - >120 mi. federal mileage rate/mi. in effect when travel occurs.

**Special Provision:** Travel is paid only at the beginning and end of the job.

**Per Diem:**

- **All Districts**
  - 0-70 mi. free zone
  - >70-120 mi. $55.00/day
  - >120 mi. $70.00/day

## BRICK, BLOCK, AND STONE MASONS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
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<td>District 3</td>
<td>$25.82</td>
<td>$12.47</td>
</tr>
<tr>
<td>District 4</td>
<td>$25.10</td>
<td>$12.25</td>
</tr>
</tbody>
</table>

**Travel:**

- **All Districts**
  - 0-45 mi. free zone
  - >45-60 mi. $25.00/day
  - >60-90 mi. $55.00/day
  - >90 mi. $65.00/day

## CARPENTERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$21.50</td>
<td>$11.57</td>
</tr>
<tr>
<td>District 2</td>
<td>$21.50</td>
<td>$11.86</td>
</tr>
<tr>
<td>District 3</td>
<td>$21.50</td>
<td>$11.57</td>
</tr>
<tr>
<td>District 4</td>
<td>$21.50</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

**Zone Pay:**

- **All Districts**
  - 0-30 mi. free zone
  - >30-50 mi. base pay + $4.00/hr.
  - >50 mi. base pay + $6.00/hr.

**Duties Include:**
Install roll and batt insulation.

## CEMENT MASONS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$18.92</td>
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<td>District 2</td>
<td>$21.43</td>
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<tr>
<td>District 3</td>
<td>$19.52</td>
<td>$9.26</td>
</tr>
<tr>
<td>District 4</td>
<td>$22.12</td>
<td>$9.26</td>
</tr>
</tbody>
</table>

**Zone Pay:**

- **District 1**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $1.05/hr.
  - >60 mi. base pay + $1.50/hr.

- **Districts 2 - 4**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $2.95/hr.
  - >60 mi. base pay + $4.75/hr.

**Duties Include:**
Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs. Align forms for sidewalks, curbs, or gutters.
## Construction Equipment Operators Group 1

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$24.07</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 2</td>
<td>$24.07</td>
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<tr>
<td>District 3</td>
<td>$24.07</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 4</td>
<td>$24.07</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Air Compressor; Auto Fine Grader; Belt Finishing; Boring Machine (Small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front-End Loader, under 1 cu. yd; Oiler, Heavy Duty Drills; Herman Nelson Heater; Mucking Machine; Oiler, All Except Cranes/Shovels; Pumpman.

### Zone Pay:
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.

## Construction Equipment Operators Group 2

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$25.54</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 2</td>
<td>$25.54</td>
<td>$11.40</td>
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<tr>
<td>District 3</td>
<td>$25.54</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 4</td>
<td>$25.54</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Air Doctor; Backhoe\Excavator\Shovel, up to and incl. 3 cu. yds; Bit Grinder; Bituminous Paving Travel Plant; Boring Machine, Large; Broom, Self-Propelled; Concrete Travel Batch; Concrete Float & Spreader; Concrete Bucket Dispatcher; Concrete Finish Machine; Concrete Conveyor; Distributor; Dozer, Rubber-Tired, Push, & Side Boom; Elevating Grader\Gradall; Field Equipment Serviceman; Front-End Loader, 1 cu. yd up to and incl. 5 cu. yds; Grade Setter; Heavy Duty Drills, All Types; Hoist\Tugger, All; Hydralift Forklifts & Similar; Industrial Locomotive; Motor Patrol (except finish); Mountain Skidder; Oiler, Cranes/Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumpcrete\Grout Machine; Punch Truck; Roller, other than Asphalt; Roller, Sheepsfoot (Self-Propelled); Roller, 25 tons and over; Ross Carrier; Rotomill, under 6 ft; Trenching Machine; Washing /Screening Plant.

### Zone Pay:
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.
### CONSTRUCTION EQUIPMENT OPERATORS GROUP 3

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$25.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>2</td>
<td>$25.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>3</td>
<td>$25.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>4</td>
<td>$25.95</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Asphalt Paving Machine; Asphalt Screed
- Backhoe\Excavator\Shovel, over 3 cu. yds; Cableway Highline
- Concrete Batch Plant; Concrete Curing Machine; Concrete Pump; Cranes, Creter; Cranes, Electric Overhead; Cranes, 24 tons and under; Curb Machine; Slip Form Paver; Finish Dozer; Front-End Loader, over 5 cu. yds; Mechanic\Welder; Pioneer Dozer; Roller Asphalt (Breakdown & Finish); Rotomill, over 6 ft; Scraper, Single, Twin, or Pulling Belly-Dump; YO-YO Cat.

### Zone Pay:
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.

### CONSTRUCTION EQUIPMENT OPERATORS GROUP 4

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$26.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>2</td>
<td>$26.95</td>
<td>$11.40</td>
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<tr>
<td>3</td>
<td>$26.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>4</td>
<td>$26.95</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Asphalt\Hot Plant Operator; Cranes, 25 tons up to and incl. 44 tons; Crusher Operator; Finish Motor Patrol; Finish Scraper.

### Zone Pay:
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.

### CONSTRUCTION EQUIPMENT OPERATORS GROUP 5

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$27.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>2</td>
<td>$27.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>3</td>
<td>$27.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>4</td>
<td>$27.95</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Cranes, 45 tons up to and incl. 74 tons.

### Zone Pay:
- **All Districts**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $3.50/hr.
  - >60 mi. base pay + $5.50/hr.
CONSTRUCTION EQUIPMENT OPERATORS GROUP 6

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$28.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 1</td>
<td>$28.95</td>
<td>$11.40</td>
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<tr>
<td>District 2</td>
<td>$28.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 3</td>
<td>$28.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 4</td>
<td>$28.95</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to: Cranes, 75 tons up to and incl. 149 tons; Cranes, Whirley (All).

Zone Pay:
All Districts
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

CONSTRUCTION EQUIPMENT OPERATORS GROUP 7

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$29.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 1</td>
<td>$29.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 2</td>
<td>$29.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 3</td>
<td>$29.95</td>
<td>$11.40</td>
</tr>
<tr>
<td>District 4</td>
<td>$29.95</td>
<td>$11.40</td>
</tr>
</tbody>
</table>

This group includes but is not limited to: Cranes, 150 tons up to and incl. 250 tons; Cranes, over 250 tons—add $1.00 for every 100 tons over 250 tons; Crane, Tower (All); Crane Stiff-Leg or Derrick; Helicopter Hoist.

Zone Pay:
All Districts
0-30 mi. free zone
>30-60 mi. base pay + $3.50/hr.
>60 mi. base pay + $5.50/hr.

CONSTRUCTION LABORERS GROUP 1/FLAG PERSON FOR TRAFFIC CONTROL

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$19.08</td>
<td>$9.10</td>
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<tr>
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<td>$19.08</td>
<td>$9.10</td>
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<tr>
<td>District 2</td>
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<td>$8.65</td>
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<tr>
<td>District 3</td>
<td>$18.00</td>
<td>$7.90</td>
</tr>
<tr>
<td>District 4</td>
<td>$18.00</td>
<td>$7.17</td>
</tr>
</tbody>
</table>

Zone Pay:
District 1
0-30 mi. free zone
>30-60 mi. base pay + $1.50/hr.
>60 mi. base pay + $2.00/hr.

District 2
0-15 mi. free zone
>15-30 mi. base pay + $0.75/hr.
>30-50 mi. base pay + $1.50/hr.
>50 mi. base pay + $2.25/hr.

Districts 3 & 4
0-15 mi. free zone
>15-30 mi. base pay + $0.65/hr.
>30-50 mi. base pay + $0.85/hr.
>50 mi. base pay + $1.25/hr.
# Construction Laborers Group 2

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$18.82</td>
<td>$8.38</td>
</tr>
<tr>
<td>District 2</td>
<td>$18.86</td>
<td>$6.53</td>
</tr>
<tr>
<td>District 3</td>
<td>$16.78</td>
<td>$4.40</td>
</tr>
<tr>
<td>District 4</td>
<td>$18.12</td>
<td>$4.65</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- General Labor
- Asbestos Removal
- Burning Bar
- Bucket Man
- Carpenter Tender
- Caisson Worker
- Cement Mason Tender
- Cement Handler (dry)
- Chuck Tender
- Choker Setter
- Concrete Worker
- Curb Machine-lay Down
- Crusher and Batch Worker
- Heater Tender
- Fence Erector
- Landscape Laborer
- Landscaper
- Lawn Sprinkler Installer
- Pipe Wrapper
- Pot Tender
- Powderman Tender
- Rail and Truck Loaders and Unloaders
- Riprappper
- Sign Erection
- Guardrail and Jersey Rail
- Spike Driver
- Stake Jumper
- Signalman
- Tail Hoseman
- Tool Checker and Houseman
- Traffic Control Worker.

## Zone Pay:

- **District 1**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $1.50/hr.
  - >60 mi. base pay + $2.00/hr.

- **District 2**
  - 0-15 mi. free zone
  - >15-30 mi. base pay + $1.55/hr.
  - >30-50 mi. base pay + $3.10/hr.
  - >50 mi. base pay + $4.65/hr.

- **Districts 3 & 4**
  - 0-15 mi. free zone
  - >15-30 mi. base pay + $0.65/hr.
  - >30-50 mi. base pay + $0.85/hr.
  - >50 mi. base pay + $1.25/hr.

# Construction Laborers Group 3

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$19.48</td>
<td>$9.10</td>
</tr>
<tr>
<td>District 2</td>
<td>$19.58</td>
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<tr>
<td>District 3</td>
<td>$19.00</td>
<td>$7.90</td>
</tr>
<tr>
<td>District 4</td>
<td>$19.00</td>
<td>$7.17</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
- Concrete Vibrator
- Dumpman (Grademan)
- Equipment Handler
- Geotextile and Liners
- High-Pressure Nozzlesman
- Jackhammer (Pavement Breaker) Non-Riding Rollers
- Pipelayer
- Posthole Digger (Power)
- Power Driven Wheelbarrow
- Rigger
- Sandblaster
- Sod Cutter-Power and Tamper.

## Zone Pay:

- **District 1**
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $1.50/hr.
  - >60 mi. base pay + $2.00/hr.

- **District 2**
  - 0-15 mi. free zone
  - >15-30 mi. base pay + $0.75/hr.
  - >30-50 mi. base pay + $1.50/hr.
  - >50 mi. base pay + $2.25/hr.

- **Districts 3 & 4**
  - 0-15 mi. free zone
  - >15-30 mi. base pay + $0.65/hr.
  - >30-50 mi. base pay + $0.85/hr.
  - >50 mi. base pay + $1.25/hr.
**CONSTRUCTION LABORERS GROUP 4**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$18.74</td>
<td>$9.10</td>
</tr>
<tr>
<td>2</td>
<td>$19.81</td>
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<tr>
<td>3</td>
<td>$20.55</td>
<td>$6.78</td>
</tr>
<tr>
<td>4</td>
<td>$18.55</td>
<td>$6.97</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
Hod Carrier; Water Well Laborer; Blaster; Wagon Driller; Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete) Powderman; Rock & Core Drill; Track or Truck Mounted Wagon Drill and Welder incl. Air Arc.

***Hod Carriers will receive the same amount of travel and/or subsistence pay as bricklayers when requested to travel.

**ZONE PAY:**

**District 1**
- 0-30 mi. free zone
- >30-60 mi. base pay + $1.50/hr.
- >60 mi. base pay + $2.00/hr.

**District 2**
- 0-15 mi. free zone
- >15-30 mi. base pay + $1.55/hr.
- >30-50 mi. base pay + $3.10/hr.
- >50 mi. base pay + $4.65/hr.

**District 3**
- 0-30 mi. free zone
- >30-60 mi. base pay + $2.95/hr.
- >60 mi. base pay + $4.70/hr.

**District 4**
- 0-15 mi. free zone
- >15-30 mi. base pay + $0.65/hr.
- >30-50 mi. base pay + $0.85/hr.
- >50 mi. base pay + $1.25/hr.

**DRYWALL APPLICATORS**

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$23.81</td>
<td>$11.57</td>
</tr>
<tr>
<td>2</td>
<td>$21.50</td>
<td>$11.86</td>
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<tr>
<td>3</td>
<td>$21.50</td>
<td>$11.57</td>
</tr>
<tr>
<td>4</td>
<td>$21.50</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

Duties Include:
Drywall and ceiling tile installation.

**ZONE PAY:**

**All Districts**
- 0-30 mi. free zone
- >30-50 mi. base pay + $4.00/hr.
- >50 mi. base pay + $6.00/hr.
ELECTRICIANS: INCLUDING BUILDING AUTOMATION CONTROL

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$26.85</td>
<td>$10.69</td>
</tr>
<tr>
<td>District 2</td>
<td>$29.06</td>
<td>$13.13</td>
</tr>
<tr>
<td>District 3</td>
<td>$27.58</td>
<td>$  9.92</td>
</tr>
<tr>
<td>District 4</td>
<td>$30.73</td>
<td>$12.37</td>
</tr>
</tbody>
</table>

Duties Include:
Electrical wiring; equipment and fixtures; street lights; electrical control systems. Installation and/or adjusting of building automation controls also during testing and balancing, commissioning and retro-commissioning.

Travel:
<table>
<thead>
<tr>
<th>District 1</th>
<th>0-10 mi. free zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10-45 mi.</td>
<td>$0.585/mi. in excess of the free zone.</td>
</tr>
<tr>
<td>&gt;45 mi.</td>
<td>$65.00/day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>District 2</th>
<th>0-08 mi. free zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;08-50 mi.</td>
<td>federal mileage rate/mi. in effect when travel occurs, in excess of the free zone.</td>
</tr>
<tr>
<td>&gt;50 mi.</td>
<td>$62.50/day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>District 3</th>
<th>0-08 mi. free zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;08-50 mi.</td>
<td>federal mileage rate/mi. in effect when travel occurs, in excess of the free zone.</td>
</tr>
<tr>
<td>&gt;50 mi.</td>
<td>$62.50/day</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>District 4</th>
<th>0-18 mi. free zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;18-60 mi.</td>
<td>federal mileage rate/mi. in effect when travel occurs and employee uses own vehicle.</td>
</tr>
<tr>
<td>&gt; 60 mi.</td>
<td>$75.00/day (In Big Sky)</td>
</tr>
</tbody>
</table>

Per Diem:
<table>
<thead>
<tr>
<th>District 3</th>
<th>$65.00/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$75.00/day (In Big Sky)</td>
</tr>
</tbody>
</table>

ELEVATOR CONSTRUCTORS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$47.76</td>
<td>$32.38</td>
</tr>
<tr>
<td>District 2</td>
<td>$47.76</td>
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<tr>
<td>District 3</td>
<td>$47.76</td>
<td>$32.38</td>
</tr>
<tr>
<td>District 4</td>
<td>$47.76</td>
<td>$32.38</td>
</tr>
</tbody>
</table>

Travel:
<table>
<thead>
<tr>
<th>All Districts</th>
<th>0-15 mi. free zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;15-25 mi.</td>
<td>$38.28/day</td>
</tr>
<tr>
<td>&gt;25-35 mi.</td>
<td>$76.56/day</td>
</tr>
<tr>
<td>&gt;35 mi.</td>
<td>$72.55/day or cost of receipts for hotel and meals, whichever is greater.</td>
</tr>
</tbody>
</table>

FLOOR LAYERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$19.00</td>
<td>No Rate Established</td>
</tr>
<tr>
<td>District 2</td>
<td>$19.00</td>
<td>No Rate Established</td>
</tr>
<tr>
<td>District 3</td>
<td>$19.00</td>
<td>No Rate Established</td>
</tr>
<tr>
<td>District 4</td>
<td>$19.00</td>
<td>No Rate Established</td>
</tr>
</tbody>
</table>

Travel:
<table>
<thead>
<tr>
<th>All Districts</th>
<th>0-120 mi. free zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;120 mi.</td>
<td>$45.00/day</td>
</tr>
</tbody>
</table>
GLAZIERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$18.28</td>
<td>$2.30</td>
</tr>
<tr>
<td>District 2</td>
<td>$17.97</td>
<td>$1.00</td>
</tr>
<tr>
<td>District 3</td>
<td>$19.69</td>
<td>$4.52</td>
</tr>
<tr>
<td>District 4</td>
<td>$20.43</td>
<td>$6.31</td>
</tr>
</tbody>
</table>

Per Diem:
- **District 1**: Motel + $24.00/day
- **Districts 2**: $35.00/day
- **District 3**: All meals rooms and gas paid for by employer
- **District 4**: $100/day

HEATING AND AIR CONDITIONING

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
<td>$25.37</td>
<td>$12.63</td>
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<tr>
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<tr>
<td>District 3</td>
<td>$24.61</td>
<td>$14.44</td>
</tr>
<tr>
<td>District 4</td>
<td>$27.33</td>
<td>$14.44</td>
</tr>
</tbody>
</table>

Travel:
- **All Districts**: 0-51 mi. free zone
- >51mi. **$0.25/mi.** in employer vehicle
  - **$0.65/mi.** in employee vehicle

Per Diem:
- **All Districts**: $60.00/day

INSULATION WORKERS-MECHANICAL (HEAT AND FROST)

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>District 1</td>
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<tr>
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<tr>
<td>District 3</td>
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<td>$17.57</td>
</tr>
<tr>
<td>District 4</td>
<td>$32.32</td>
<td>$17.57</td>
</tr>
</tbody>
</table>

Travel:
- **All Districts**: 0-30 mi. free zone
- >30-40 mi. **$20.00/day**
- >40-50 mi. **$30.00/day**
- >50-60 mi. **$40.00/day**
- >60 mi. **$45.00/day + $0.56/mi.** if transportation is not provided / **$0.20/mi.** if in company vehicle.

Per Diem:
- **All Districts**: $77.00/day on jobs requiring an overnight stay + $0.56/mi. if transportation is not provided / $0.20/mi. if in company vehicle.

Duties Include:
- Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work.
- Insulate pipes, ductwork or other mechanical systems.
### Ironworkers-Structural Steel and Rebar Placers

<table>
<thead>
<tr>
<th>District</th>
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<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$25.90</td>
<td>$20.73</td>
</tr>
<tr>
<td>2</td>
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<td>$18.84</td>
</tr>
<tr>
<td>4</td>
<td>$26.50</td>
<td>$19.03</td>
</tr>
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</table>

**Duties Include:**
- Structural steel erection; assemble prefabricated metal buildings; cut, bend, tie, and place rebar; energy producing windmill type towers; metal bleacher seating; handrail fabrication and ornamental steel.

**Travel:**
- **District 1**
  - 0-45 mi. free zone
  - >45-60 mi. $30.00/day
  - >60-100 mi. $55.00/day
  - >100 mi. $75.00/day
- **Districts 2 - 4**
  - 0-45 mi. free zone
  - >45-85 mi. $45.00/day
  - >85 mi. $75.00/day

### Millwrights

<table>
<thead>
<tr>
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<tbody>
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<tr>
<td>4</td>
<td>$30.00</td>
<td>$11.57</td>
</tr>
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</table>

**Zone Pay:**
- **All Districts**
  - 0-30 mi. free zone
  - >30-50 mi. base pay + $4.00/hr.
  - >50 mi. base pay + $6.00/hr.

### Painters: Including Paperhanger

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
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<td>4</td>
<td>$14.43</td>
<td>$7.50</td>
</tr>
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</table>

**Travel:**
- **All Districts**
  - 0-120 mi. free zone
  - >120 mi. $45.00/day

### Pile Bucks

<table>
<thead>
<tr>
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<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
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<td>$11.57</td>
</tr>
<tr>
<td>4</td>
<td>$27.00</td>
<td>$11.57</td>
</tr>
</tbody>
</table>

**Zone Pay:**
- **All Districts**
  - 0-30 mi. free zone
  - >30-50 mi. base pay + $4.00/hr.
  - >50 mi. base pay + $6.00/hr.

**Duties Include:**
- Set up crane; set up hammer; weld tips on piles; set leads; insure piles are driven straight with the use of level or plum bob. Give direction to crane operator as to speed and direction of swing. Cut piles to grade.
PLASTERERS

<table>
<thead>
<tr>
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<tr>
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<tr>
<td>District 4</td>
<td>$22.12</td>
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</tr>
</tbody>
</table>

Zone Pay:
- **District 1**:
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $1.05/hr.
  - >60 mi. base pay + $1.50/hr.
- **Districts 2 - 4**:
  - 0-30 mi. free zone
  - >30-60 mi. base pay + $2.95/hr.
  - >60 mi. base pay + $4.75/hr.

PLUMBERS, PIPEFITTERS, AND STEAMFITTERS

<table>
<thead>
<tr>
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<th>Wage</th>
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<tbody>
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<tr>
<td>District 4</td>
<td>$29.86</td>
<td>$15.11</td>
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</table>

Duties Include:
Assemble, install, alter, and repair pipe-lines or pipe systems that carry water, steam, air, other liquids or gases. Testing of piping systems, commissioning and retro-commissioning. Workers in this occupation may also install heating and cooling equipment and mechanical control systems.

Travel:
- **District 1**:
  - 0-30 mi. free zone
  - >30-50 mi. $20.00/day
  - >50-75 mi. $35.00/day
  - >75 mi. $70.00/day
- **Districts 2 & 3**:
  - 0-40 mi. free zone
  - >40-80 mi. $30.00/day
  - >80 mi. $60.00/day
- **District 4**:
  - 0-70 mi. free zone
  - >70 mi. $0.55/mi. if transportation is not provided.

Special Provision:
If transportation is not provided, an additional $0.35/mi. is added to the amounts above for travel at the beginning and end of job, not for every mile traveled.

Per Diem:
- **District 4**: $90.00/day

Special Provision:
If employee travels back and forth from home to job site, the employee will receive compensation for no more than two trips.
## ROOFERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
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<td>$3.90</td>
</tr>
<tr>
<td>4</td>
<td>$18.02</td>
<td>$4.15</td>
</tr>
</tbody>
</table>

### Travel:
- **District 1**
  - 0-50 mi. free zone
  - >50 mi. $0.30/mi.

### Special Provision:
Travel is paid only one way.

### Districts 2 - 4
- 0-30 mi. free zone
- >30 mi. $0.25/mi. when using employees vehicle.

### Per Diem:
- **Districts 2 - 4**
  - $55.00/day or actual expenses (verified with receipts) for board and room provided.

## SHEET METAL WORKERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>$25.37</td>
<td>$12.63</td>
</tr>
<tr>
<td>2</td>
<td>$24.24</td>
<td>$14.44</td>
</tr>
<tr>
<td>3</td>
<td>$24.61</td>
<td>$14.44</td>
</tr>
<tr>
<td>4</td>
<td>$27.33</td>
<td>$14.44</td>
</tr>
</tbody>
</table>

### Duties Include:
Testing and balancing, commissioning and retro-commissioning of all air-handling equipment and duct work.

### Travel:
- **All Districts**
  - 0-51 mi. free zone
  - >51 mi. $0.25/mi. in employer vehicle
  - $0.65/mi. in employee vehicle

### Per Diem:
- **All Districts**
  - $60.00/day

## SPRINKLER FITTERS

<table>
<thead>
<tr>
<th>District</th>
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<td>$18.22</td>
</tr>
<tr>
<td>4</td>
<td>$28.87</td>
<td>$10.52</td>
</tr>
</tbody>
</table>

### Travel:
- **All Districts**
  - 0-60 mi. free zone
  - >60-80 mi. $16.50/day
  - >80-100 mi. $26.50/day
  - >100 mi. $80.00/day

## TAPERS

<table>
<thead>
<tr>
<th>District</th>
<th>Wage</th>
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<tbody>
<tr>
<td>1</td>
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<td>$23.14</td>
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<td>$7.50</td>
</tr>
<tr>
<td>4</td>
<td>$23.14</td>
<td>$7.50</td>
</tr>
</tbody>
</table>

### Travel:
- **All Districts**
  - 0-120 mi. free zone
  - >120 mi. $45.00/day
TEAMSTERS GROUP 2

<table>
<thead>
<tr>
<th>Wage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$26.06</td>
<td>$9.16</td>
</tr>
</tbody>
</table>

This group includes but is not limited to:
Combination Truck and Concrete Mixer and Transit Mixer; Dry Batch Trucks; Distributor Driver; Dumpman; Dump Trucks and similar equipment; Dumpster; Flat Trucks; Lumber Carriers; Lowboys; Pickup; Powder Truck Driver; Power Boom; Serviceman; Service Truck/Fuel Truck/Tireperson; Truck Mechanic; Trucks with Power Equipment; Warehouseman, Partsman, Cardex and Warehouse Expeditor; Water Trucks.

Zone Pay:
0-25 mi. free zone
>25-50 mi. base pay + $2.50/hr.
>50 mi. base pay + $3.00/hr.

TELECOMMUNICATIONS EQUIPMENT INSTALLERS

<table>
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<tr>
<th>Wage</th>
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</tr>
</thead>
<tbody>
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<tr>
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<td>$7.20</td>
</tr>
<tr>
<td>District 4 $24.11</td>
<td>$7.11</td>
</tr>
</tbody>
</table>

Duties Include:
Install voice; sound; vision and data systems. This occupation includes burglar alarms, fire alarms, fiber optic systems, and video systems for security or entertainment.

Travel:
All Districts
The federal mileage rate/mi. in effect when travel occurs if using own vehicle.

Per Diem:
All Districts
Employer pays for meals and lodging up to $65.00/day. When jobsite is located in Big Sky, West Yellowstone and Gardiner, lodging and meals will be provided by the employer for all actual and reasonable expenses incurred.

TILE AND MARBLE SETTERS

No Rate Established

Duties Include:
Apply hard tile, marble, and wood tile to floors, ceilings, and roof decks
ARTICLE 3 – THE CONTRACTOR

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.6 ADD: PRODUCT DELIVERY, STORAGE AND HANDLING

3.3.6.1 ADD: Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer’s written instructions.

3.3.6.2 ADD: DELIVERY AND HANDLING:

3.3.6.2.1 ADD: Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

3.3.6.2.2 ADD: Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3.3.6.2.3 ADD: Deliver products to Project site in an undamaged condition in manufacturer’s original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

3.3.6.2.4 ADD: Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and property protected.

3.3.6.3 ADD: STORAGE

3.3.6.3.1 ADD: Store products to allow for inspection and measurement of quantity or counting of units

3.3.6.3.2 ADD: Store materials in a manner that will not endanger Project structure.

3.3.6.3.3 ADD: Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

3.3.6.3.4 ADD: Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

3.3.6.3.5 ADD: Comply with product manufacturer’s written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

3.3.6.3.6 ADD: Protect stored products from damage and liquids from freezing.

3.11 DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE

3.11.4 ADD: All as-built conditions shall be kept current and the contractor shall not permanently conceal or cover any work until all required information has been recorded.

3.11.5 ADD: All survey and exterior underground utilities shall be recorded using the spatial reference, Montana State Plane, NAD 83, CORS 96, Lambert Conformal Conic. The National Geodetic Survey publishes NAD 83 coordinates in the metric system (i.e., meters). The conversion factor that should be used to convert between English and metric systems is the international conversion factor of 1 ft. = 0.3048 m. coordinate system.
3.11.6 ADD: In marking any as-built conditions, the contractor shall ensure that such drawings indicate by measured dimension to building corners or other permanent monuments the exact locations of all piping, conduit or utilities concealed in concrete slabs, behind walls or ceilings or underground. Record drawings shall be made to scale and shall also include exact locations of valves, pull boxes and similar items as required for maintenance or repair service.

3.12.1 DEFINITIONS:

3.12.1.4 ADD: Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term “product” includes the terms “material,” “equipment,” “system,” and terms of similar intent.

3.12.1.5 ADD: Named Products: Items identified by manufacturer’s product name, including make or model number or other designation shown or listed in manufacturer’s published product literature that is current as of date of the Contract Documents.

3.12.1.6 ADD: New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3.12.1.7 ADD: Comparable Products: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

3.12.1.8 ADD: Basis-of-Design Product Specification: A specification in which a specific manufacturer’s product is named and accompanied by the words “basis-of-design product,” including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specifications.

3.13. USE OF SITE

3.13.5 ADD: By acceptance of MSU Building Keys the Contractor agrees with the following: University keys are the property of Montana State University. Fabricating, duplicating or modifying University keys is prohibited. Doors must remain locked at all times. The use of these keys to allow unauthorized persons to enter the above areas is prohibited. Loss of any key must be reported immediately to the Director, Office of Facilities Services and University Police, if the loss of keys results in re-keying costs, these costs will be charged to the Contractor. See attached Estimated Re-Keying Costs per Building.

3.13.6 ADD: The Montana Legislature decreed that the “right to breathe smoke-free air has priority over the desire to smoke” (MCA 20-40-102). It is the policy of MSU to promote the health, wellness and safety of all employees, students, guests, visitors, and contractors while on campus. Therefore, the campus will be free of tobacco-use effective August 1, 2012. The use of tobacco (including cigarettes, cigars, pipes, smokeless tobacco and all other tobacco products) by students, faculty, staff, guests, visitors, and contractors is prohibited on all properties owned or leased by MSU.

3.13.7 ADD: Littering any university property, whether owned or leased, with the remains of tobacco products is prohibited. All university employees, students, visitors, guests, and contractors are required to comply with this policy, which shall remain in effect at all times. Refusal to comply with this policy may be cause for disciplinary action in accordance with employee and student conduct policies. Refusal to comply with the policy by visitors, guests and contractors may be grounds for removal from campus. (http://www2.montana.edu/policy/smoking_facilities/)

3.13.8 ADD: The Contractor may use the University’s toilet facilities only as directed by the Owner.

ARTICLE 8 - TIME

8.3. DELAYS AND EXTENSIONS OF TIME

8.3.4 ADD: By the act of signing the Contract, the Contractor signifies that he/she and all subcontractors can perform the work within the stated schedule and that subcontractors, manufacturers, suppliers, and deliverers are known to be able to support the schedule. Time extension may be granted for unforeseen conditions or events out of the Contractor’s control causing delay in delivery of materials or causing delay in the Contractor’s ability to perform the work within the Contract
Documents. The Contractor is expected to take all possible measures and bear all reasonable costs in order to anticipate, control, counteract, and expedite such delay-causing conditions, including finding alternative sources of materials, equipment, shipping, and labor. Notification of any claim for schedule delay must be made in writing to the Owner within one week of the causing event or of first knowledge of a known delay causing condition with supporting documentation as required by the Owner. The Owner will respond in writing within one week to claims of delay. No claims of delay will be entertained after the date of completion as stated on the Notice to Proceed or as extended by previously approved delay claims.

END OF SUPPLEMENTARY GENERAL CONDITIONS
## Cost Estimate to Re-key Buildings

<table>
<thead>
<tr>
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<th>Core #</th>
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<th>Budget</th>
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<td>Animal BioScience</td>
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<td>ARC</td>
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<tr>
<td>Athletics (Fieldhouse etc.)</td>
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## PROJECT CLOSEOUT CHECKLIST

**PROJECT TITLE:** ____________________________  
**CONTRACTOR:** ____________________________  
**PPA No.** ____________________________  
**DATE:** ____________________________  
**CONSULTANT** ____________________________  

**In absence of a Consultant, responsibilities will be determined at Pre-construction meeting**

### To be submitted with Application of Final Payment

<table>
<thead>
<tr>
<th>Contract Requirements</th>
<th>Date PM Verified</th>
<th>Date Completed</th>
<th>Required Documentation:</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td>Contractors Affidavit of Completion, MSU Form106 (all contracts)</td>
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<td>Final application for payment (all contracts)</td>
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<td>Certificate of Substantial Completion - MSU Form 107 (over $25K)</td>
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<td>Certificate of Final Acceptance - MSU Form118 (over $25K)</td>
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<td>Consent of Surety to final payment MSU Form103 (if over $25K)</td>
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### MSU PM

| Verification of All Change Orders & Final Amounts with Contract amounts |

**Contractor to submit all deliverables to the Consultant**

<table>
<thead>
<tr>
<th>Contractor Requirements</th>
<th>Demonstration &amp; Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Bozeman Building Permits:</td>
<td>Fire Suppression test &amp; Certificate</td>
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<tr>
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<td>Fire Alarm test &amp; Certificate</td>
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<tr>
<td></td>
<td>Elevator Inspection</td>
</tr>
<tr>
<td></td>
<td>Plumbing &amp; HVAC test &amp; Inspection</td>
</tr>
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</table>

| Final project inspection |
| Notification of completion of punch list |
| Copy of warranty Binder |

### Consultant Requirements

| Operation & Maintenance Manuals: including warrantees or guarantees for all equipment |
| (3 copies – project, trades, building file, support manager: PDF & Paper) |
| HVAC |
| Plumbing |
| Electrical |
| Elevator |
| Fire Alarm |
| Roof |
| Project Manual (Divisions 1-13) |

### Consultant Signature ____________________________  
**Project Manager** ____________________________  

| Submit at Record Document Stage/Consultant shall submit Contractor Deliverables to Owner |

| Complete set of record drawings (PDF & AutoCAD files to CADD Mgr) | 2 Paper sets |
| Operation & Maintenance Manuals: including warrantees or guarantees for all equipment (3 copies – project, trades, building file, support manager: PDF & Paper) |

**Consultant Signature** ____________________________  
**Project Manager** ____________________________
SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work under separate contracts.
5. Access to site.
6. Coordination with occupants.
7. Work restrictions.
8. Specification and drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

A. Project Identification: NAIC Parking Garage and related site improvements. This project is the first phase of a large campus facility called the Norm Asbjornson Innovation Center (NAIC).

1. Project Location: SW corner of Grant and S 7th Avenue, Montana State University, Bozeman, MT.


1. Owner's Representative: Sam J. DesJardins, Project Manager.

C. Architect: A&E Architects, PC, Billings, MT.

D. General Contractor/Construction Manager (GC/CM): Martel Construction, Bozeman, MT.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Construction of a 179,744 sf, four-level, cast-in-place, post-tensioned parking garage for 550 vehicles including two stair towers, one elevator, and related site work.

B. Type of Contract.

1. Project will be constructed under a single prime contract.
1.4 PHASED CONSTRUCTION

A. The NAIC Parking Garage and related site work will be completed as a single phase of construction. This project will be the first phase of the multi-phase NAIC project.

B. Before commencing Work, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates and occupancy schedule the project.

1.5 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

B. Subsequent Work: Owner will award separate contract(s) for the following additional work to be performed at the site. Completion of that work will depend on successful completion of preparatory work under this Contract.

1. Norm Asbjornson Innovation Center: Martel Construction will be the GC/CM for the construction of a multi-purpose classroom, research, and presentation facility adjacent to the Parking Garage.

1.6 ACCESS TO SITE

A. General: Contractor shall have full use of Project site as defined in the drawings for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to areas defined in the drawings.
2. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving adjacent facilities clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.7 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy the adjacent site and adjacent building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: See GC/CM Requirements for Trade Contractors.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.

D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.

E. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes.

F. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.10 MISCELLANEOUS PROVISIONS

A. See GC/CM Requirements for Trade Contractors.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000
SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

   1. Substitution Request Form: Use CSI Form 13.1A.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
      b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.
      f. Certificates and qualification data, where applicable or requested.
      g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
      h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
      i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

k. Cost information, including a proposal of change, if any, in the Contract Sum.

l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify GC/CM of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.


b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

b. Requested substitution will not adversely affect Contractor's construction schedule.

c. Requested substitution has received necessary approvals of authorities having jurisdiction.

d. Requested substitution is compatible with other portions of the Work.

e. Requested substitution has been coordinated with other portions of the Work.

f. Requested substitution provides specified warranty.

g. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed unless otherwise indicated.
C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:

   a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   
   b. Requested substitution does not require extensive revisions to the Contract Documents.
   
   c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   
   d. Requested substitution will not adversely affect Contractor's construction schedule.
   
   e. Requested substitution has received necessary approvals of authorities having jurisdiction.
   
   f. Requested substitution is compatible with other portions of the Work.
   
   g. Requested substitution has been coordinated with other portions of the Work.
   
   h. Requested substitution provides specified warranty.
   
   i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's construction schedule.
2. Construction schedule updating reports.
3. Daily construction reports.
4. Site condition reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
C. Contractor’s Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

1.4 COORDINATION

A. Coordinate Contractor’s construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR’S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.

6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Work Restrictions: Show the effect of the following items on the schedule:
   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
   g. Seasonal variations.
   h. Environmental control.

5. Work Stages: Indicate important stages of construction for each major portion of the Work.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed.
B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

   a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Utility interruptions.
   g. Installation.
   h. Work by Owner that may affect or be affected by Contractor's activities.
   i. Testing.
   j. Punch list and final completion.
   k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
   
   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

   1. Contractor or subcontractor and the Work or activity.
   2. Description of activity.
   3. Main events of activity.
   4. Immediate preceding and succeeding activities.
   5. Early and late start dates.
   6. Early and late finish dates.
   7. Activity duration in workdays.
   8. Total float or slack time.
   10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

   1. Identification of activities that have changed.
   2. Changes in early and late start dates.
   3. Changes in early and late finish dates.
   5. Changes in the critical path.
   6. Changes in total float or slack time.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions, including presence of rain or snow.
   7. Accidents.
   8. Meetings and significant decisions.
   9. Unusual events.
   10. Stoppages, delays, shortages, and losses.
   11. Meter readings and similar recordings.
   13. Orders and requests of authorities having jurisdiction.
   14. Change Orders received and implemented.
   15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR’S CONSTRUCTION SCHEDULE

A. Contractor’s Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.

B. Related Requirements:
   1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit unaltered, original, full-size image files within three days of taking photographs.
   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Identification: Provide the following information with each image description in file metadata tag:
      a. Name of Project.
      b. Name and contact information for photographer.
      c. Date photograph was taken.
      d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, with minimum size of 8 megapixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.
B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
   
   1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
   
   1. Date and Time: Include date and time in file name for each image.
   2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.

D. Preconstruction Photographs: Before commencement of demolition and excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   
   1. Flag construction limits before taking construction photographs.
   2. Take a minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
   3. Take a minimum of 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

E. Periodic Construction Photographs: Take a minimum of 20 photographs weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take a minimum of 80 color photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

G. Additional Photographs: Architect may request photographs in addition to periodic photographs specified.
   
   1. Three days' notice will be given, where feasible.
   2. In emergency situations, take additional photographs within 24 hours of request.
   3. Circumstances that could require additional photographs include, but are not limited to, the following:
      
      a. Special events planned at Project site.
      b. Immediate follow-up when on-site events result in construction damage or losses.
      c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
      d. Substantial Completion of a major phase or component of the Work.
      e. Extra record photographs at time of final acceptance.
      f. Owner's request for special publicity photographs.

END OF SECTION 013233
SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:
   1. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
   2. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
   3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   4. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS


      a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

      b. Contractor shall execute a data licensing agreement in the form of AIA Document C106, Digital Data Licensing Agreement.
B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
   a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Construction Manager.
   e. Name of Contractor.
   f. Name of subcontractor.
   g. Name of supplier.
   h. Name of manufacturer.
   i. Submittal number or other unique identifier, including revision identifier.
   1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
   j. Number and title of appropriate Specification Section.
   k. Drawing number and detail references, as appropriate.
   l. Location(s) where product is to be installed, as appropriate.
   m. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.

a. Transmittal Form for Paper Submittals: Use CSI Form 12.1A included in Project Manual.
b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

1) Project name.
2) Date.
3) Destination (To:).
4) Source (From:).
5) Name and address of Architect.
6) Name of Construction Manager.
7) Name of Contractor.
8) Name of firm or entity that prepared submittal.
9) Names of subcontractor, manufacturer, and supplier.
10) Category and type of submittal.
11) Submittal purpose and description.
12) Specification Section number and title.
13) Specification paragraph number or drawing designation and generic name for each of multiple items.
14) Drawing number and detail references, as appropriate.
15) Indication of full or partial submittal.
16) Transmittal number, numbered consecutively.
17) Submittal and transmittal distribution record.
18) Remarks.
19) Signature of transmitter.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner, containing the following information:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Name of firm or entity that prepared submittal.
g. Names of subcontractor, manufacturer, and supplier.
h. Category and type of submittal.
i. Submittal purpose and description.
j. Specification Section number and title.
k. Specification paragraph number or drawing designation and generic name for each of multiple items.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
   a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

F. Options: Identify options requiring selection by Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect’s action stamp.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect’s action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

   1. Post electronic submittals as PDF electronic files directly to [Project Web site] [Architect’s FTP site] specifically established for Project.

   2. Submit electronic submittals via email as PDF electronic files.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
   b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
   a. Manufacturer's catalog cuts.
   b. Manufacturer's product specifications.
   c. Standard color charts.
   d. Statement of compliance with specified referenced standards.
   e. Testing by recognized testing agency.
   f. Application of testing agency labels and seals.
   g. Notation of coordination requirements.
   h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
   a. PDF electronic file.
   b. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Identification of products.
   b. Schedules.
   c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).

3. Submit Shop Drawings in the following format:
   a. PDF electronic file.
   b. Three opaque copies of each submittal. Architect will retain two copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.

3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.

  1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least [three] <Insert number> sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Submit product schedule in the following format:

   a. PDF electronic file.
   b. Three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.

F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

I. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
SUBMITTAL PROCEDURES

Q. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.

S. Schedule of Tests and Inspections: Comply with requirements specified in Section 014000 "Quality Requirements."

T. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

U. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

V. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

W. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 “Closeout Procedures.”

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

3. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of [five] <Insert number> previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.


B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
QUALITY REQUIREMENTS

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer’s Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Permits, Licenses, and Certificates: For Owner’s records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   d. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
   a. Allow seven days for initial review and each re-review of each mockup.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.


1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.
F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections attached to this Section, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.
B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000
SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
8. ACI - American Concrete Institute; (Formerly: ACI International); [www.abma.com](http://www.abma.com).
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
13. AIA - Associated Institute of Architects (The); [www.aiain.org](http://www.aiain.org).
23. API - American Petroleum Institute; (See AHRI).
25. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).
26. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
29. ASSE - American Society of Safety Engineers (The); [www.asse.org](http://www.asse.org).
34. AWI - Architectural Woodwork Institute; [www.awinett.org](http://www.awinett.org).
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFEMA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CRI - Carpet & Rug Institute (The); www.carpet-rug.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ELA - Electronic Industries Alliance; (See TIA).
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
REFERENCES

90. GS - Green Seal; www.greenseal.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
120. LMA - Laminating Materials Association; (See CPA).
123. MCA - Metal Construction Association; www.metalconstruction.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
REFERENCES

140. NECA - National Electrical Contractors Association; www.necanet.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - NFPA International; (See NFPA).
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NRCA - National Roofing Contractors Association; www.nrca.net.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Door Institute; www.steeldoors.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
REFERENCES

196. USAV - USA Volleyball; www.usavolleyball.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCM - Window Covering Manufacturers Association; www.wcmnet.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. COE - Army Corps of Engineers; www.usace.army.mil.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list.
REFERENCES

2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS; California Department of Health Services; (See CDPH).
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservicetamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200
SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers’ standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

   a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.


1.4 QUALITY ASSURANCE
A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES
A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
PRODUCT REQUIREMENTS

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience may be considered.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
PRODUCT REQUIREMENTS

A. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience may be considered.

b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000
SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
3. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural element during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that could, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility or Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect.

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work.
Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.


2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements"

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300
SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Section 017900 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.2 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.
1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
   a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
5. Submit test/adjust/balance records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.
Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to GC/CM Requirements for Trade Contractors.
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:
   a. MS Excel electronic file. Architect will return annotated copy.

1.8 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal’s GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer’s written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

   d. Remove tools, construction equipment, machinery, and surplus material from Project site.

   e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

k. Remove labels that are not permanent.

l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

p. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

   a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700
SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:
   a. Initial Submittal:
      1) Submit [one] <Insert number> paper-copy set(s) of marked-up record prints.
      2) Submit PDF electronic files of scanned record prints and [one] <Insert number> set(s) of file prints.
      3) Submit record digital data files and [one] <Insert number> set(s) of plots.
      4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
   b. Final Submittal:
      1) Submit [three] <Insert number> paper-copy set(s) of marked-up record prints.
      2) Submit PDF electronic files of scanned record prints and [three] <Insert number> set(s) of prints.
      3) Print each drawing, whether or not changes and additional information were recorded.
   c. Final Submittal:
      1) Submit [one] paper-copy set(s) of marked-up record prints.
      2) Submit record digital data files and [three] <Insert number> set(s) of record digital data file plots.
      3) Plot each drawing file, whether or not changes and additional information were recorded.
B. Record Specifications: Submit [one paper copy] [Insert number> paper copies] [annotated PDF electronic files] of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit [one paper copy] [Insert number> paper copies] [annotated PDF electronic files and directories] of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Record data as soon as possible after obtaining it.
   c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.

3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Format: Annotated PDF electronic file[ with comment function enabled].

3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

4. Identification: As follows:
   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Architect[ and Construction Manager].
   e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as [annotated PDF electronic file] [paper copy] [scanned PDF electronic file(s) of marked-up paper copy of Specifications].

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as [annotated PDF electronic file] [paper copy] [scanned PDF electronic file(s) of marked-up paper copy of Product Data].

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as [PDF electronic file] [paper copy] [scanned PDF electronic file(s) of marked-up miscellaneous record submittals].

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839
SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
   b. Enable inserted reviewer comments on draft submittals.
2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.

C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.

C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

G. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic
sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

2. Identify each binder on front and spine, with printed title “OPERATION AND MAINTENANCE MANUAL,” Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.

4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.
2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

   1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823
SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit [two] <Insert number> copies within [seven] <Insert number> days of end of each training module.

1. At completion of training, submit complete training manual(s) for Owner's use [prepared and bound in format matching operation and maintenance manuals] [in PDF electronic file format on compact disc].

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training.
1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Owner will furnish an instructor to describe Owner's operational philosophy.
   3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Owner, through Architect, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of [an oral] [a written] [a demonstration] performance-based test.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Narration: Describe scenes on video recording by [audio narration by microphone while] [dubbing audio narration off-site after] video recording is recorded. Include description of items being viewed.

D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900
### SUBSTITUTION REQUEST
(After the Bidding Phase)

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<td>Copyright 1996, Construction Specification Institute, 601 Madison Street, Alexandria, VA 22314-1791 Page of September 1996 CSI Form 13.1A</td>
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The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:

Signed by:

Firm: ____________________________
Address: ____________________________
Telephone: ____________________________
Attachments: ____________________________

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: ____________________________ Date: ____________________________

Additional Comments: ____________________________
☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ ____________________________
AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Party transmitting Digital Data (“Transmitting Party”):
(Name, address and contact information, including electronic addresses)

« »
« »
« »
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« »

and the Party receiving the Digital Data (“Receiving Party”):
(Name, address and contact information, including electronic addresses)

« »
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for the following Project:
(Name and location or address)

«Billings Clinic Family Birth Center Remodel/Addition Project»
«2800 10th Ave North
Billings, MT 59101»

In consideration of the following promises exchanged, the Parties agree as follows:
TABLE OF ARTICLES
1 GENERAL PROVISIONS
2 TRANSMISSION OF DIGITAL DATA
3 LICENSE CONDITIONS
4 LICENSING FEE OR OTHER COMPENSATION

ARTICLE 1 GENERAL PROVISIONS
§ 1.1 The purpose of this Agreement is to grant a license from the Transmitting Party to the Receiving Party for the Receiving Party’s use of Digital Data on the Project, and to set forth the license terms.

§ 1.2 This Agreement is the entire and integrated agreement between the parties. Except as specifically set forth herein, this agreement does not create any other contractual relationship between the parties.

§ 1.3 Digital Data is defined as information, communications, drawings, or designs created or stored for the Project in digital form.

§ 1.3.1 Confidential Information is defined as Digital Data that the Transmitting Party has designated as confidential and clearly marked with an indication such as “Confidential” or “Business Proprietary.”

ARTICLE 2 TRANSMISSION OF DIGITAL DATA
§ 2.1 The Transmitting Party grants the Receiving Party a nonexclusive limited license to use the Digital Data solely and exclusively to perform services or construction for the Project in accordance with the conditions set forth in Article 3.

§ 2.2 The transmission of Digital Data constitutes a warranty by the Transmitting Party to the Receiving Party that the Transmitting Party (1) is the copyright owner of the Digital Data, (2) has permission from the copyright owner to transmit the Digital Data and grant a license for its use on the Project, or (3) is authorized to transmit Confidential Information.

§ 2.3 The Transmitting Party retains its rights in the Digital Data. By transmitting the Digital Data, the Transmitting Party does not grant to the Receiving Party an assignment of those rights; nor does the Transmitting Party convey to the Receiving Party any right in the software used to generate the Digital Data.

§ 2.4 To the fullest extent permitted by law, the Receiving Party shall indemnify and defend the Transmitting Party from and against all claims arising from or related to the Receiving Party’s modification to, or unlicensed use of, the Digital Data.

§ 2.5 The Receiving Party agrees to keep Confidential Information strictly confidential and not to disclose it to any other person except to (1) its employees, (2) those who need to know the content of the Confidential Information in order to perform services or construction solely and exclusively for the Project, or (3) its consultants and contractors whose contracts include similar restrictions on the use of Confidential Information.

ARTICLE 3 LICENSE CONDITIONS
§ 3.1 The parties agree to the following conditions on the limited license granted in Section 2.1:
(State below rights or restrictions applicable to the Receiving Party’s use of the Digital Data, requirements for data format, transmission method or other conditions on data to be transmitted.)

ARTICLE 4 LICENSING FEE OR OTHER COMPENSATION
§ 4.1 The Receiving Party agrees to pay the Transmitting Party the following fee or other compensation for the Receiving Party’s use of the Digital Data:
# SUBMITTAL TRANSMITTAL

**Project:**

**Date:**

**A/E Project Number:**

---

**TRANSMITTAL**

**To (Contractor):**

**Date:**

**Submittal No.:**

**From (Subcontractor):**

**By:**

- [ ] Resubmission

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<th>Qty.</th>
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<th>Title / Description / Manufacturer</th>
<th>Spec. Section Title and Paragraph / Drawing Detail Reference</th>
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- [ ] Submitted for review and approval
- [ ] Resubmitted for review and approval
- [ ] Complies with contract requirements
- [ ] Will be available to meet construction schedule
- [ ] A/E review time included in construction schedule

**Other remarks on above submission:**

---

**TRANSMITTAL**

**To (Contractor):**

**Attn:**

**Date Rec'd by Contractor:**

**From (Contractor):**

**By:**

- [ ] Revise / Resubmit
- [ ] Rejected / Resubmit

**Other remarks on above submission:**

---

**TRANSMITTAL**

**To (Contractor):**

**Attn:**

**Date Rec'd by A/E:**

**From (A/E):**

**Other By:**

**By:**

- [ ] Approved
- [ ] Approved as noted
- [ ] Provide file copy with corrections identified
- [ ] Sepia copies only returned
- [ ] Point-by-point comparative data required to complete approval process
- [ ] Submission Incomplete / Resubmit

**Other remarks on above submission:**

---

**TRANSMITTAL**

**To (Subcontractor):**

**Attn:**

**Date Rec'd by Contractor:**

**From (Contractor):**

**By:**

- [ ] One copy retained by sender

**Copies:**

- [ ] Owner
- [ ] Consultants
- [ ] Other

---

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CSI Form 12.1A
(State the fee, in dollars, or other method by which the Receiving Party will compensate the Transmitting Party for the Receiving Party’s use of the Digital Data.)

This Agreement is entered into as of the day and year first written above and will terminate upon Substantial Completion of the Project, as that term is defined in AIA Document A201™–2007, General Conditions of the Contract for Construction, unless otherwise agreed by the parties and set forth below. (Indicate when this Agreement will terminate, if other than the date of Substantial Completion.)

TRANSMITTING PARTY (Signature)  
(RECEIVING PARTY (Signature)

(Printed name and title)  
(Printed name and title)
## Punch List

The following items require the attention of the Contractor for completion or correction. This list may not be all-inclusive, and the failure to include any items on this list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

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**Attachments**

Signed by: ___________________________  Date: ______________

Copies:  

- [ ] Owner
- [ ] Consultants
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] _____
- [ ] File

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September 1996  CSI Form 14.1A
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- **001116** INVITATION TO BID
- **001120** INSTRUCTIONS TO BIDDERS
- **001130** BID PACKAGE DESCRIPTIONS & SCHEDULE
- **001150** BID FORM

### GC/CM SAMPLE DOCUMENTS

- **AIA A312** PERFORMANCE AND PAYMENT BOND – BY REFERENCE ONLY
- **AIA A401** STANDARD FORM OF AGREEMENT BETWEEN CONTRACTOR & SUBCONTRACTOR

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- **01006** SUBTRADE CONTRACTOR BONDS & CERTIFICATES OF INSURANCE
- **01250** SUBTRADE CONTRACT MODIFICATION PROCEDURES
- **01291** SUBTRADE CONTRACTOR APPLICATIONS FOR PAYMENT
- **01310** SUBTRADE PROJECT MANAGEMENT AND COORDINATION
- **015000** TEMPORARY FACILITIES AND CONTROLS
- **017419** CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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- **ST OF MT** GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION – GC/CM - STATE
- **MTANIA** MONTANA PREVAILING WAGE RATES FOR BUILDING CONSTRUCTION SERVICES – 2015
- **MSU SUPPLEMENTAL** MSU SUPPLEMENTAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

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- **012500** SUBSTITUTION PROCEDURES
- **013200** CONSTRUCTION PROGRESS DOCUMENTATION
- **013233** PHOTOGRAPHIC DOCUMENTATION
- **013300** SUBMITTAL PROCEDURES
- **014000** QUALITY REQUIREMENTS
- **014200** REFERENCES
- **016000** PRODUCT REQUIREMENTS
- **017000** EXECUTION REQUIREMENTS
- **017700** CLOSEOUT PROCEDURES INCLUDING MSU CLOSEOUT REQUIREMENTS
- **017810** PROJECT RECORD DOCUMENTS
- **017823** OPERATION AND MAINTENANCE DATA
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**Architects: A&E / ZGF**

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**M-E-P Engineers: ACE / AEI**

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**Lab Consultant: RFD**

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<tr>
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**Civil, Geotech, Transportation, and Survey Engineers: DOWL HKM**

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**Structural Engineer: Morrison-Maierle**

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**Landscape Architect: Land Design**

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**Acoustic Consultant: Big Sky Acoustics**

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**Technology Consultant: Access Consulting**

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**Parking Consultant: Walker Parking**

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**Audio Visual Design: Onpoint Designs**

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SECTION 02 32 00 - GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes geotechnical data.

1.2 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. A geotechnical investigation report for Parking Garage at Proposed Norm Asbjornson Innovation Center, Montana State University, Bozeman, Montana, prepared by DOWL, dated June 18, 2015, is available for viewing as appended to this Document.

END OF SECTION 023200

Attachment to follow: Geotechnical Report (88 pages)
SECTION 02 41 00 – SITE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. This section includes demolition, salvage and removal of selected site structures, utilities and surfacing.

1.2 RELATED REQUIREMENTS

A. Section 31 1000 - Site Clearing.
B. Section 31 2000 - Earth Moving.

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

Standard Specifications:


2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.

3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.3 COORDINATION

A. Conduct pre-demolition conference to cover the following:

4. Identify items to be protected and preserved before proceeding with work.

5. Conduct a walking inspection to identify materials and equipment to be salvaged for re-installation and Owner use.

6. During the walking inspection, photograph or otherwise determine and record existing physical conditions of boundary areas. Surfaces, equipment, or other items damaged during demolition work are to be restored to original condition as recorded during the walking inspection.

7. Agree upon location where items salvaged for Owner are to be delivered and stored.

B. Prior to closing or obstructing streets, walks, or other adjacent occupied facilities, obtain written permission from the authorities having jurisdiction. Provide alternate vehicular and pedestrian routes in accordance with the requirements of the Owner and governing authorities. Provide, erect, and maintain temporary barriers and security devices.
C. Traffic and Passageways:

1. Conduct demolition operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
2. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
3. Provide temporary alternate vehicular and pedestrian traffic routes as required to complete the work and in accordance with the requirements of the Owner and governing authorities. Provide, erect, and maintain temporary barriers and security devices.
4. Maintain free and safe passage to and from Owner occupied areas.

D. Coordinate shut-off, capping, and continuation of utility services with Owner prior to any planned mechanical, electrical, and plumbing shutdowns. Schedule site demolition and removal work to ensure uninterrupted service of all utilities, or to obtain prior approval from the Owner for type, start date and duration of planned service outages.

E. Coordinate with the Owner to schedule irrigation shutdowns, demolition and replacement, and to provide temporary irrigation as required.

1.4 OBSTRUCTIONS

A. Some obstructions may not appear on the Drawings. Bidders are advised to carefully inspect the existing site before preparing their proposals. The protection or removal and replacement of minor obstructions such as fences, pipe, and similar items shall be anticipated and accomplished even though not shown or specifically mentioned.

B. Major obstructions encountered that are not shown on the Drawings, or could not have been foreseen by visual inspection of the site prior to bidding, should immediately be brought to the attention of the Architect. The Architect will make a determination for proceeding with the work. If the Architect finds that the obstruction adversely affects the Contractor's costs or schedule of completion, a proper adjustment to the Contract will be made in accordance with the General Conditions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Mark and identify location of utilities to be disconnected.

B. The Contractor is advised that there is a One-Call utility locate number in use for utility location requests within the state of Montana for buried utilities. The one call number is 1-800424-5555. MCA 69-4-501 through 69-4-506 requires the use of the One Call system prior to any excavation work in Montana.

C. The Contractor shall be responsible for having the appropriate utility or Owner turn off all services before demolition is started. Notify affected utility company in advance of date and time when service needs to be disconnected.
3.2 PROTECTION

A. Protect existing utilities, structures and other facilities to remain, including supporting soils, from damage at all times during performance of the work.

B. Protect improvements on adjoining properties as well as those on Owner's property.

C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as necessary for safety and to support the structure and protect it from movement, settlement or damage.

D. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain in place.

E. Protect trees, shrubs and other vegetation unless specifically identified for demolition. Cut and remove tree branches only where, in the opinion of the Owner and Architect, such cutting is necessary to perform the specified work.

F. Restore improvements damaged by the Work to their original condition as acceptable to Owners or other parties or authorities having jurisdiction.

G. Protect salvageable items from damage.

H. Monuments and Markers: Preserve and protect survey monuments, benchmarks and markers from damage or displacement throughout construction. If damage occurs or removal becomes necessary, immediately notify Architect and restore monument or marker to original condition.

3.3 SALVAGEABLE IMPROVEMENTS

A. Carefully remove, store and protect materials and equipment indicated to be salvaged, and deliver to locations on the Owner's premises as directed by the Owner.

B. Carefully remove, store, and protect items noted on Drawings for salvage and re-installation. Store these items at locations as directed by the Owner.

C. Materials Retained by Contractor:
   1. Items of salvageable value not specified to be salvaged or re-installed, once removed, become the property of the Contractor and shall be removed as work progresses.
   2. On-site storage of salvaged items for sale on site will not be permitted.

3.4 STRUCTURE DEMOLITION

A. Perform demolition in accordance with governing authorities. Cease demolition operations immediately if adjacent structures appear to be in danger.

B. Remove existing curbs, gutters and concrete surfacing to existing joints or to neatly cut lines where no joints exist.

C. Pavement Removal: Asphalt and concrete pavement to be removed is shown on the Drawings or is above locations where new piping is to be installed. Remove existing pavement and material below the pavement to a depth sufficient to allow replacement of pavement, sub-base aggregate and base
course aggregate materials to the specified depths below the finished grade elevations indicated on the Drawings. Pavement to be removed shall be separated from pavement to remain by neat, vertically cut edges using a pavement breaker, cutting wheel or other Engineer-approved means.

D. Utilities:

1. Where electrical, natural gas, telephone, or any other utility lines are exposed by demolition excavation, the Contractor shall immediately notify the owner(s) of these utilities that their facilities have been exposed, and shall allow sufficient time for the utility to either re-locate their facilities or to determine that they have been abandoned. Rearrange demolition schedule as necessary to continue overall project progress without delay.

2. The Contractor shall be responsible for having the appropriate utility or Owner turn off all services before demolition is started. Notify affected utility company in advance of date and time when service needs to be disconnected.

3. Remove all buried overhead and underground utilities within the work area (grading limits) that have been abandoned previously or will be abandoned by this project.

4. Disconnect and cap utility services; comply with requirements of governing authorities. Do not commence demolition operations until associated disconnections have been completed.

5. If not in the construction area for the new facilities, all abandoned piping, fittings, and similar items may be left in place or removed at the Contractor's option.

6. All sanitary sewer lines, water lines, storm drain lines, culverts, utility conduits, and gas lines over 2 inches in diameter to be abandoned in place shall be plugged at the cut ends with concrete to form a tight closure with a length of at least 5 pipe diameters.

7. Submit record documents identifying actual locations of capped or abandoned existing utilities encountered during performance of the specified work.

A. Fencing and/or hand railing indicated on the drawings to remain may be removed by the Contractor at his option as an aid for construction access. Where such fencing is removed, all fence materials must be replaced in their original condition and location after construction is complete. Any fencing materials damaged by the Contractor's removal or other construction activities must be replaced with new materials matching the existing materials at no extra cost to the Owner.

B. Repair or replace, at Owner's option, demolition performed in excess of that required. Replacement will be at the sole expense of the Contractor.

3.5 HAZARDOUS MATERIALS

C. Inform Architect and Owner immediately upon discovery of asbestos products, radioactive materials, radon gas, toxic wastes, or other similar hazardous materials. Do not remove hazardous materials without Owner authorization.

D. Explosives are not permitted.

3.6 DEBRIS AND WASTE REMOVAL

A. All material and items not specified to be salvaged shall be removed and legally disposed of offsite by the Contractor. The Contractor shall make all necessary arrangements for this disposal, and shall bear any costs or retain any profit incidental to this disposal.

B. Recycle materials to the greatest extent possible.
C. No burning of debris is allowed on site.

3.7 CLEANING

A. Broom clean demolition areas of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing prior to start of work.

B. Remove temporary work and protection when no longer needed.

END OF SECTION 024100
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

   A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

      1. Footings.
      2. Foundation walls.
      3. Slabs-on-grade.
      4. Suspended slabs.
      5. Building frame members.

   B. Related Sections:

      1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
      2. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
      3. Division 3 Section “Unbonded Post-Tensioned Concrete.”
      4. Division 7 “Traffic Coatings.”
      5. Division 7 “Water Repellants.”
      6. Division 7 “Expansion Joint Assemblies.”
      7. Division 7 “Concrete Joint Sealants.”
      8. Division 9 “Painting.”
      9. Division 9 “Pavement Marking.”

1.3 DEFINITIONS

   A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

   A. Product Data: For each type of product indicated.

   B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Data for Credit IEQ 4.3: For curing and sealing compounds, documentation including printed statement of VOC content.

3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Proportion mixtures as defined in ACI 301 Section 4 header “Proportioning.” Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
3. Proportion mixtures to minimize effects of thermal and drying shrinkage. See Part 2 heading “Concrete Mixtures” header “Shrinkage” for drying shrinkage limit.
4. For each concrete mixture, which identifies the following:
   a. Mixture Proportions Identification and use.
   b. Method used for documentation of required average compressive strength, (ACI 301 Section 4 – Field test data or Trial mixtures).
   c. Gradation of fine and coarse aggregates.
   d. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
   e. Water/cementitious materials ratio.
   f. Slump, ASTM C143.
   g. Certification of the chloride content of admixtures.
   h. Air Content:
      1) Of freshly mixed concrete by pressure method, ASTM C231, or volumetric method, ASTM C173.
      2) Of hardened concrete by microscopical determination, including parameters of air-void system, ASTM C457.
   i. Freeze-thaw resistance, ASTM C457 and C666. If super-plasticized concrete cannot meet hardened air content requirements of Part 2, ASTM C666 laboratory test result of specimens with concrete mixture proportions similar to proposed mixture for project shall be submitted for review by Engineer. Report air void parameters (spacing and specific surface area in accordance with ASTM C457) of specimens tested. Test specimens shall contain specified air system (within plus or minus 1.5 percent) and high-range water-reducer (superplasticizer) used in concrete for project. Report relative durability factor of concrete for specimens tested in accordance with Procedure A of ASTM C666. Acceptable concrete durability factor greater than 90 percent (> 90%) at 300 test cycles. Relative durability factor of concrete containing superplasticizer greater than or equal to 80 percent (≥ 80%) compared with reference.
   k. Strength at 4 and 28 days, ASTM C39. In addition, for post-tensioned concrete provide a strength gain curve with sufficient number of data points from 6 to 96 hours to accurately estimate when the minimum compressive strength for
tensioning the concrete will be achieved. See Section “Unbonded Post-Tensioned Concrete.”

m. Rapid Chloride Permeability test results per ASTM C 1202, for concrete in post tensioned slabs. Charge passed shall be less than 2000 coulombs.
n. Shrinkage (length change), ASTM C157 (modified) for cast-in-place post-tensioned concrete only. See Part 2 heading “Concrete Mixtures” header “Shrinkage” for modifications to ASTM C157.
o. Certificate of analysis of coal fly ash Comply with ASTM C618, Class C or F:

D. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor, Owner’s Quality Assurance and Special Inspections personnel and Concrete Supplier. Include following information:

1. See Article “Quality Assurance.”
5. Air content of freshly mixed concrete by pressure method, ASTM C 231 or volumetric method, ASTM C 173.
6. Air content and parameters of air-void system by microscopical determination, ASTM C 457, when required by paragraph 3.17.
7. Concrete temperature at placement time. ASTM C 1064.
8. Air temperature at placement time.
10. Rapid Chloride Permeability Test of core samples in accordance with ASTM C 1202, as and when directed by Specification or Owner.
11. Shrinkage (length change) of superstructure concrete, ASTM C 157 (modified) for post-tensioned concrete, as and when directed by Specification or Owner. Shrinkage shall be equal to or less than 0.04% at 28 days.

E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

F. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

H. Samples: For waterstops.
1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Waterstops.
   6. Curing compounds.
   7. Floor and slab treatments.
  10. Semirigid joint filler.
  12. Repair materials.

D. Submit certification that curing compound or evaporation reducer, if used, is compatible with sealer specified in Division 7 “Water Repellants” and traffic topping specified in Division 7 “Traffic Coatings, and sealants specified in Division 7 “Concrete Joint Sealants.”

E. Submit certification that curing compound or evaporation reducer, if used, is compatible with pavement marking specified in Division 9 “Painting.”

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

G. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

H. Field quality-control reports.

I. Minutes of preinstallation conference.

J. Submit concrete Manufacturer NRMCA “Certification of Ready Mix Concrete Production Facilities” for approval and verification.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Special concrete finish subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, shoring and reshoring procedures, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.


E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.
2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) ASTM A 706/A 706M, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch (300-mm) bar length.

E. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.


2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II Type III as indicated herein , gray . Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F or C.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: As indicated in drawings
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.5 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italcementi Group, Inc.; CATEXOL CN-Cl.
b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
c. Euclid Chemical Company (The), an RPM company; .
d. Grace Construction Products, W. R. Grace & Co.; DCI.
e. Sika Corporation; Sika CNI.
f. Minimum dosages shall be 3 gal. per cubic yard.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
b. Cortec Corporation; MCI- 2000 2005NS.
c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
d. Sika Corporation; FerroGard 901.
e. Minimum dosage shall be 3 gal. per cubic yard.

E. Alkali-Silica Reaction Inhibiting Admixture.

1. Products:
   b. “Eucon Integral ARC,” Euclid Chemical Co.
   c. “Sika Control ASR”, Sika Corporation.

2. Include water content in admixture when calculating water-to-cement ratio.
3. Provide satisfactory CE CRD-C667 results with lithium admixture as defined in “Alkali-Aggregate Reactivity Resistance” paragraph below.

F. Shrinkage Reducing Admixture:

1. Design requires using materials with combined drying shrinkage characteristic of 0.04 percent maximum at 28 days. Proposed concrete Mixture(s), using actual aggregates, admixtures and cement of the proposed mix for Project as detailed herein and in Drawings, shall meet criteria. Submit ASTM C 157 (may be modified by curing period duration) results for at least 3 specimens. Test takes 28 days minimum. Begin tests as soon as possible so final test results available for submittal to Engineer.
2. Products: Subject to compliance with requirements, provide one of following:
   a. If calcium nitrite is present in the original concrete mixture:
      2) “Eucon SRA +” Euclid Chemical Company.
      3) “Sika Control 40”, Sika Corporation.

   b. If calcium nitrite is not present in the original concrete mixture:
      1) “Eucon SRA,” or “Eucon SRA+,” Euclid Chemical Company.
      4) “Sika Control 40,” Sika Corporation.

G. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches (25 to 57 mm) long.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. 3M; Scotchcast Polyolefin Fibers 1”.
   b. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
2.6 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
   b. CETCO; Volclay Waterstop-RX.
   c. Concrete Sealants Inc.; Conseal CS-231.
   d. Greenstreak; Swellstop.
   e. Henry Company, Sealants Division; Hydro-Flex.
   f. JP Specialties, Inc.; Earth Shield Type 20.

B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   b. Greenstreak; Hydrotite.
   c. Vinylex Corp.; Swellseal.

2.7 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. ChemMasters; Chemisil Plus.
   b. ChemTec Int'l; ChemTec One.
   c. Conspec by Dayton Superior; Intraseal.
   d. Curecrete Distribution Inc.; Ashford Formula.
   e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
   f. Edoco by Dayton Superior; Titan Hard.
2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italacementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.

2. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals - Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.9 RELATED MATERIALS


B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.
B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
   3. Slump Limit: As indicated in Drawings
   4. Air Content: As indicated in Drawings

B. Foundation Walls/Grade Beams: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: As indicated in Drawings
   3. Slump Limit: As indicated in Drawings
   4. Air Content: As indicated in Drawings

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 5000 psi (34.5 MPa) at 28 days.
   3. Slump Limit: As Indicated in Drawings
   4. Air Content: As indicated in Drawings
   5. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer. Refer to Part 1 Article “Submittals.”
   6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4.0 lb/cu. yd. (2.4 kg/cu. m).

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 5000 psi (34.5 MPa) at 28 days. See unbonded post-tensioning specification for high early strength requirements.
   3. Slump Limit: As indicated in Drawings
   4. Air Content: As indicated in Drawings
   5. Hardened concrete shall have an air void spacing factor of 0.0080 in. maximum. Specific surface (surface area of air voids) shall be 600 in² per cu in. of air-void volume, or greater. Concrete mixes not meeting these values as determined by ASTM C 457 may require adjustments unless accepted in writing by Engineer. Refer to Part 1 Article “Submittals.”
   6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4.0 lb/cu. yd. (2.4 kg/cu. m).

E. Chloride Ion Content of Mixture:
   1. Water soluble chloride ion content of concrete shall not exceed 0.06 percent by weight of cement for pre-stressed concrete and 0.15 percent for reinforced concrete. (ACI 318 Chapter 4 Table 4.4.1"Maximum Chloride Ion Content for Corrosion Protection of Reinforcement") Test to determine chloride ion content shall conform to ASTM C 1218.
   2. Concrete chloride ion content shall be determined by Testing Agency prior to placement. Cast samples from current production of concrete mix proposed for superstructure.
3. Concrete not meeting the requirements of paragraph “Water soluble chloride ion content of concrete...” above, shall contain appropriate amount of calcium nitrite. Concrete supplier shall provide laboratory test results showing the amount of excess chloride ion content in the concrete mixture contributed by the aggregates. For each pound of chloride ion in excess of the amount allowed, mix shall contain calcium nitrite (30 percent, plus or minus 2 percent, solids content) on one-to-one basis (one gallon of calcium nitrite for one lb of excess chloride ion). Calcium nitrate used to offset chloride ions is in addition to calcium nitrate used as a corrosion inhibitor. Maximum of 1.5 lb of chloride ion per cubic yard may be offset in this manner.

F. Alkali-Aggregate Reactivity Resistance: Provide one of the following:

1. Total equivalent alkali content of mixture less than 5 lb/cu. yd.
2. ASTM C1293: Expansion less than 0.04 % after 1 year for each of the aggregates (both coarse and fine) in the proposed concrete mixture. This data shall be less than 1 year old.
3. ASTM C1260: Expansion less than 0.1 % after 14 days for each of the aggregates (both coarse and fine) in the proposed concrete mixture.
4. ASTM C1567: Expansion less than 0.1 % after 14 days with each of the aggregates (both coarse and fine) and the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design. Alternatively, if satisfactory ASTM C1260 test results can be provided for one of the aggregates that are being used, ASTM C1567 testing does not need to be provided for that aggregate.
5. CE CRD-C662: Expansion less than 0.1 % after 28 days with each of the aggregates (both coarse and fine), the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design and the lithium admixture source and dosage level of the proposed mixture design. Alternatively, if satisfactory ASTM C1260 test results can be provided for one of the aggregates that are being used, CRD-C662 testing does not need to be provided for that aggregate.

G. Shrinkage (Length Change):

1. Determine length change of hardened concrete test specimens in accordance with ASTM C 157, except as noted in paragraph below. Existing test data from previous project with same materials may be acceptable.
2. Test specimens shall be moist cured, including period in molds for 7 days. Then store specimens in air for period of 28 days.
3. Utilize concrete materials and mix proportions submitted, for use in floor slab beam, in accordance with Part 1 Article “Submittals”.
4. Report length change of specimens after periods of air drying after curing of 4, 7, 14, 21, and 28 days.
5. Average length change after 28 days shall be limited to 0.04%, unless otherwise accepted by Engineer. Values exceeding 0.04% shall be rejected.

H. Building Frame Members: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 5000 psi (34.5 MPa) at 28 days.
2. Maximum Water-Cementitious Materials Ratio: As indicated in drawings
3. Slump Limit: As indicated in Drawings
4. Air Content: As indicated in Drawings

I. Building Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
3. Slump Limit: As indicated in Drawings
4. Air Content: As indicated in Drawings

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer’s written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC’s “Code of Standard Practice for Steel Buildings and Bridges.”

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 “Joint Sealants,” are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.7 WATERSTOPs

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer’s written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.
3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer or authorizing agent.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

D.

3.10 FINISHING FLOORS AND SLABS

A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom or Belt Finish"):

1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is discouraged; however, if they are used the following applies:
   a. Use minimal passes so as to not overwork the concrete.
   b. At the contractor's expense a petrographic analysis will be required in each area where a power trowel is used to verify the air content at the slab surface is within specified limits.
2. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.
3. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
4. Before installation of flatwork and after submittal, review, and approval of concrete mixture proportions, Contractor shall fabricate two acceptable test panels simulating finishing techniques and final appearance to be expected and used on Project. Test panels shall be minimum of 10 ft. by 10 ft. in area and shall be reinforced and cast to thickness of typical parking and drive area wearing surface in Project. (Maximum thickness of test panels need not exceed 6 in.) Test panels shall be cast from concrete supplied by similar concrete batch, both immediately after addition of superplasticizer or water-reducing admixture, and at maximum allowed time for use of admixture-treated concrete in accordance with Specifications. Intent of test panels is to simulate both high and low workability mixes, with approximate slump at time of casting of test panels to be 6 in. and 3 in., respectively. Contractor shall finish panels following requirements of paragraphs above, and shall adjust finishing techniques to duplicate appearance of concrete surface of each panel. Finished panels (one or both) may be rejected by Engineer, in which case Contractor shall repeat procedure on rejected panel(s) until Engineer acceptance is obtained. A portion of the slab-on-grade may serve as a test panel. Accepted test panels shall be cured in accordance with Specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.

5. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.

B. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than seven days' old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.14 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

   1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original.
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concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture. Sample freshly-mixed concrete at point of final placement in accordance with ASTM C 172. Conduct one air content test per 100 yards of concrete in accordance with ASTM C 231 or ASTM C 173. Adjust air entraining admixture dosage, at plant or on site, in accordance with paragraph 2.5.I.1, if the tested air content at point of final placement deviates more than 1.5% from air content at truck.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard (4) total (6x12) cylinder specimens for each composite sample. As an alternative 4x8 cylinders are acceptable. Cast and laboratory cure (5) 4x8 cylinder specimens
   b. Cast and field cure two or as indicated by engineer, sets of two standard cylinder specimens for each composite sample of elevated slab pour.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days. For the 4x8 cylinder test two specimens at 7 day, and 3 at 28 day for a compressive strength test.
   a. Test one set of two field-cured specimens at 3 days and one set of two specimens at 28 days. For the 4x8 cylinder test two specimens at 3 day, and 3 at 28 day for a compressive strength test.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. Compression tests for post-tensioned concrete:
   a. Test one set of cylinders immediately before tensioning slabs and beams if required. Cylinders must be field cured in accordance with paragraph "Cure test cylinders per ASTM C 31...."
   b. Test one set of cylinders at 28 days.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.17 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

3.18 EVALUATION AND ACCEPTANCE OF CONCRETE

A. Discrepancies between multi-laboratory and multi-operator tests on the same material specimens shall be determined per ASTM precision and bias standards.

B. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer. Air content and parameters of air-void system shall meet requirements of this Section.

C. Core tests, may be required as directed by Engineer, in accordance with ASTM C42 and ACI 301, to evaluate non-conforming concrete.

D. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.19 ACCEPTANCE OF STRUCTURE

A. Acceptance of completed concrete Work will be according to provisions of ACI 301.

B. "RAPIDLOAD" testing is acceptable, by Structural Preservation Systems, Baltimore, MD.
C. Concrete rejected due to entrained air content below specified limit will be accepted if any of the following conditions are met:

1. ASTM C 457: Three concrete specimens tested in accordance with ASTM C 457 meet air void parameters of Part 2.
2. ASTM C 457: Three concrete specimens tested shall meet air void parameters of concrete reported and approved by Engineer in Part 1.
3. ASTM C 666, Test Procedure A: Test three concrete specimens removed from structure. Concrete specimens tested shall have durability characteristics similar to that reported in Part 1.

END OF SECTION 033000
SECTION 03 38 16 - UNBONDED POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. In accordance with Contract Documents, provide all materials, labor, equipment, and supervision to fabricate and install all post-tensioning Work. Non-prestressed reinforcement shall conform to Division 03 Section, "Cast-in-Place Concrete."

B. Meet the requirements of ACI 301, ACI 318, ACI 423.7, CRSI MSP-2, and Contract Documents. In case of a conflict, meet the more stringent requirement.

C. Related work in other Sections related to Post-Tensioned Concrete:
   1. Division 01 Section "Project Management and Coordination."
   2. Division 03 Section "Cast-in-Place Concrete."

1.3 REFERENCES

A. Field Reference: Keep a copy of the following reference in the Contractor’s field office.
   1. PTI’s “Field Procedures Manual for Unbonded Single Strand Tendons"

B. American Concrete Institute (ACI):

   1. ACI 301, "Specification for Structural Concrete."
   2. ACI 318, "Building Code Requirements for Structural Concrete."
   3. ACI 347, "Recommended Practice for Concrete Formwork."
   5. ACI 423.3R, "Recommendations for Concrete Members Prestressed with Unbonded Tendons."

C. American Society for Testing and Materials (ASTM):

   1. ASTM A416, "Specification for Uncoated Seven-Wire Strand for Prestressed Concrete."
   2. ASTM E328, "Recommended Practice for Stress-Relaxation Tests for Materials and Structures."

D. Concrete Reinforcing Steel Institute (CRSI):

E. Post-Tensioning Institute (PTI):

1. PTI, "Guide Specifications for Post-Tensioning Materials."
2. PTI, "Performance Specification for Corrosion Preventive Coating."

F. International Code Conference (ICC):

1. ICC, "International Building Code."
2. ICC, "International Building Code Standards."

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the tendon and anchor locations with Work of other Sections, including "Cast-in-Place Concrete." Immediately inform Engineer/Architect of any potential interference.

B. Sequencing:

1. Deviations in the construction and stressing sequence shown on the Drawings are not permitted without written acceptance from Engineer/Architect.

C. Submittals and Resubmittals:

1. Engineer will review each submittal the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made.
2. Circle resubmittal changes/revisions/corrections. Engineer will review only circled items and will not be responsible for non-circled changes, revisions, corrections or additions.

1.5 ACTION SUBMITTALS

A. Product Data: For each product as indicated.

1. Corrosion Inhibiting Coating: Type and chemical analysis.
2. Sheathing: Type, material, density and thickness.
3. Anchorage Device: Type, material and size.
4. Coupler Device: Type, material and size.
5. Pocket Former: Type, material and size.
6. Sheathing Repair Tape: Type, material and width.
7. Encapsulation System: Type and materials.

B. Shop Drawings: Include the following prepared by or under the supervision of a qualified professional engineer:

1. Number, arrangement and designation of tendons.
2. Tendon profile and method of tendon support. Show tendon profiles at sufficient scale to clearly indicate tendon high and low points.

3. Tendon anchorage details including bundled tendon flaring.

C. Samples: For the following products:
   1. Each anchorage assembly with a minimum of 24 inches of coated, sheathed strand.
   2. Each coupler assembly with a minimum of 24 inches of coated, sheathed strand.
   3. Encapsulation system.

D. Delegated-Design: For post-tensioning system.
   1. Signed and sealed calculations prepared by a qualified structural engineer indicating method of elongation and determination of number of tendons. Include values used for friction coefficients, anchorage seating loss, elastic shortening, creep, relaxation, wobble and shrinkage.

E. Stressing Records: Same day as stressing operation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Supplier and Installer using the forms at the end of this section.

B. Mill Test Reports: Certified mill test reports for each coil or pack of strand used on Project, indicating that strand is low relaxation and including the following information:
   1. Heat number and identification.
   3. Yield strength at 1 percent extension under load.
   4. Elongation at failure.
   5. Modulus of elasticity.
   6. Diameter and net area of strand.

C. Test and Evaluation Reports: Indicating compliance with the following requirements:
   1. Tests required by ACI 301, Section “Post-Tensioned Concrete.”
   2. Hydrostatic tests required by ACI 423.7 for “Anchorages and couplers in aggressive environments.”
   3. Relaxation loss tests required by ACI 423.7 for low relaxation prestressing steel.

D. Field Quality-Control Reports: Within 72 hours of inspection.

E. Stressing Jack Calibration: Calibration certificates for jacks and gages to be used on Project. Calibrate each jack-and-gage set as a pair.

F. Warranty: Proposed warranty prior to the start of construction.

1.7 QUALITY ASSURANCE

A. Supplier Qualifications:
1. Successfully provided all materials for at least 5 post-tensioning installations in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.

B. Installer Qualifications:

1. Certified by PTI.
2. Successfully performed at least 5 post-tensioning installations in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.
3. Use a full-time Project superintendent that has supervised at least 5 projects of similar magnitude.
4. Use PTI Certified Field Installers to oversee installation and stressing post-tensioning system.

C. Comply with requirements in ACI 301, Section “Post-Tensioned Concrete.”

D. Perform all post-tensioning Work under the supervision of a Project Superintendent who is present during all operations including installation, concrete placement, stressing and finishing.

1.8 DELIVERY, STORAGE AND HANDLING

A. Assign all tendons in same member the same heat number and identify accordingly.

B. Package each tendon bundle at source to prevent physical damage to tendon during transportation and storage, and to protect strand from moisture. Use heavy padding; cardboard is not permitted. Do not use wire binding or other materials that could cut the sheathing or tendon.

C. Deliver, store and handle post-tensioning materials according to ACI 423.7.

D. Immediately remove damaged components from Project site and replace at no cost to Owner.

E. Do not remove sheathing on stressing end until the day of stressing.

F. Materials Stored on Slabs:

1. Prior to final stressing of beams and slabs, do not store any materials on slab.
2. After final stressing of beams and slabs but before concrete has reached the specified 28 day strength, do not store materials on slab such that the weight exceeds 50 percent of the design live load.
3. After final stressing of beams and slabs and concrete has reached the specified 28 day strength, do not store materials on slab such that the weight exceeds the design live load.

1.9 WARRANTY

A. Provide a warranty from the Supplier that includes the following terms and provisions.

1. Warranty period of 5 years beginning with the date of Beneficial Occupancy.
2. Correct, at no expense to Owner, any defects that develop during the warranty period, which can be attributed to a defect in quality of product or workmanship.

3. All materials have been manufactured in accordance with the Project specifications.

4. Installation of materials, if under the control of the Supplier, has been according to the Project specifications.

5. Supplier is not responsible for damage or liability caused by the actions or omissions of others.

B. Provide a warranty from the Installer that includes the following terms and provisions.

1. Warranty period of 5 years beginning with the date of acceptance of the repair.
2. Correct, at no expense to Owner, any defects that develop during the warranty period, which can be attributed to a defect in quality of product or workmanship.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. System described in this Section intended to satisfactorily perform in ACI 362.1R-97 zone III environment without long-term corrosion or other distress for 40 years.

B. Engage a qualified professional engineer licensed in Montana to provide tendon quantity calculations and detail the tendon layout based on the following:

1. Provide the final effective forces indicated on the drawings, which are the stressing forces minus both the short- and long-term losses.
2. Do not exceed the maximum tensile stress in the tendon during the stressing operation. The maximum tensile stress is the smallest of the following:
   a. 80 percent of the specified tensile strength of the tendon.
   b. 94 percent of the specified yield strength of the tendon.
   c. Maximum value recommended by the tendon manufacturer.
3. Do not exceed 70 percent of the specified tensile strength after the anchors are seated.
4. Use PTI recommended values for friction and wobble coefficients unless test data is submitted to substantiate lower values.
5. Limit main slab tendon maximum spacing according to ACI 318, chapter “Prestressed Concrete,” heading “Slab Systems.”
6. For multi-span tendons, do not base the effective tendon force on the average stress for all spans. Calculate losses for each span independently.

2.2 PRESTRESSING TENDONS


1. Manufactured by a single source.
2. Strands manufactured outside United States subject to Engineer/Architect’s approval based on evidence of satisfactory performance in the United States during the previous 5 years.
3. Use of high stress bar system instead of strand system is not permitted unless accepted in writing by the Engineer.
4. Conform to ACI 423.7 for relaxation loss requirements.

B. Tendon Sheathing: Seamless and extruded high density polypropylene or seamless and extruded high density polyethylene with a specific gravity greater than 0.95 conforming to ACI 423.7.

1. Sufficient strength to withstand damage during fabrication, transport, installation, concrete placement and stressing.
2. Minimum thickness of 50 mils (--0 mils +15 mils)
3. Minimum inside diameter 0.03 inches greater than maximum strand diameter.
4. Chemically stable without becoming brittle or softening over anticipated temperature range and service life of structure.
5. Non-reactive with concrete, steel and corrosion inhibiting coating.
6. Contrast color of corrosion inhibiting coating to enhance visibility of damage. Black/dark colored sheathing is not acceptable.
7. Annular space between sheathing and strand completely filled with corrosion inhibiting coating.
8. Watertight including all connections and components over entire length.

C. Tendon Anchor: Non-porous casting free of sand, blow holes, voids and other defects meeting the testing and material requirements of ACI 423.7.

1. Plastic coated bearing plates sized in accordance with ACI 423.7, unless certified test reports substantiate comparable or superior performance, for transfer at minimum stressing concrete strength.
3. Capable of developing at least 95% of the actual ultimate strength of tendon.
4. Minimum wedge cavity opening of at least 0.19 inches larger than tendon diameter. Reaming of anchor wedge cavity is not permitted.
5. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.
6. Provisions for a plastic cap which fits tightly and seals barrel end on stressing side of anchor.
7. Provisions for a plastic sleeve which prevents moisture infiltration into anchor casting or tendon sheathing on bearing side of anchor.

D. Coupler Assembly: Assembly of strands and wedges meeting the testing and material requirements of ACI 301.

2. Capable of developing at least 95 percent of the ultimate strength of tendon.
3. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.
E. Encapsulation System: Watertight encapsulation along the entire length of tendon, including anchorages and couplers, when subjected to hydrostatic testing required in ACI 423.7 for aggressive environments.

1. Sleeve: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. Minimum 10 inches long and 4 inches overlap with sheathing, completely filled with corrosion inhibiting coating.
2. Anchor Cap: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. At intermediate anchorages, open to allow passage of strand.
3. Subject to the requirements provide one of the following systems:
   c. Accepted equivalent.

2.3 ACCESSORIES

A. Pocket Formers: Capable of completely sealing wedge cavity from intrusion of concrete or cement slurry; sized to provide at least a 2 inch recess and allow access for cutting strand tail.

1. If Zero Void encapsulation system in used, the “Zero Void Nail-Less Pocket Former” is required.

B. Anchorage Fasteners: Stainless-steel ring nails. Subject to the requirements use one of the following:

1. Clendenin Brothers, Baltimore, MD.
2. Swan Secure Products, Baltimore, MD.
4. Accepted equivalent.

C. Sheathing Repair Tape: Elastic, self-adhesive, moisture-proof tape with a minimum width of 2 inches in contrasting color to tendon sheathing, and that is non-reactive with sheathing, corrosion inhibiting coating, or tendon. Subject to the requirements use one of the following:

1. “3M Tape No. 226,” 3M, St. Paul, MN.
2. “Polyken 826,” Berry Plastics Corp, Evansville, IN

D. Sheathing Repair Material: For nicks and cuts less than 0.25 inches use one of the following:

1. “Scotch-Weld DP-8005,” by 3M.

E. Corrosion inhibiting coating: Capable of meeting the requirements of ACI 423.7. Subject to the requirements use one of the following:

1. “Greasrex K-218,” ExxonMobil Oil Corp., Irving, TX.
3. “Renolit PTG,” Fuch’s Lubricant Co., Harvey, IL
4. “Royal PT-1 and PT-2 Corrosion Inhibiting Grease,” Troco Oil Co., Tulsa, OK
F. Tendon supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons in place. Use tendon supports capable of meeting the requirements in CRSI’s “Manual of Standard Practice” and as follows:

1. Clearly marked to differentiate by height.
2. Capable of resisting overturning during construction operations.
3. Minimal contact with forms where concrete is exposed to view.
4. Do not cause voids or damage to surrounding concrete.
5. All-plastic supports conforming to CRSI Class 1 protection requirements and with a compressive strength higher than concrete.
6. Acceptable manufacturers:
   a. Aztec Concrete Accessories, Inc.
   b. General Technologies, Inc.
   c. Accepted equivalent.

2.4 GROUT MATERIALS

A. Premixed, nonmetallic, noncorrosive, non-staining grout product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30-minute working time.

B. Non-reactive with prestressing strand, anchorage materials, or concrete and without chlorides or other chemicals known to be deleterious to prestressing strand.

C. Subject to compliance with requirements, provide one of the following:

1. Sure Grip Grout, Dayton Superior.
2. Euco N.S., Euclid Chemical Co.
3. Masterflow 928, BASF.

PART 3 - EXECUTION

3.1 FORMWORK

A. Provide formwork for post-tensioned elements as specified in Division 03 Section, “Cast-in-Place Concrete.” Design formwork to support load redistribution that may occur during stressing operation. Ensure that formwork does not restrain elastic shortening, camber or deflection resulting from application of prestressing force.

B. Do not remove forms supporting post-tensioned elements until tendons have been fully stressed and elongations have been approved by Engineer/Architect.

3.2 TENDON INSTALLATION

A. Tendon Supports:
1. Support slab tendons independently of beam reinforcement.
2. Position supports at high and low points and at intervals not exceeding 48 inches.
3. Support tendons as required to provide the specified profile and prevent displacement during subsequent construction operations.

B. Tendon Profile:

1. Place tendons with a parabolic profile in a vertical plane conforming to control points shown on Drawings unless otherwise noted. Control points locate the center of gravity of tendons.
2. Locate low point at mid-span unless otherwise noted.
3. Maintain tendon profile with the maximum allowable deviation for corresponding member dimensions as follows:
   a. 8 inches or less: ± 0.25 inches.
   b. 8 to 24 inches: ± 0.375 inches.
   c. 24 inches or more: ± 0.5 inches.

C. Tendon Location:

1. Obtain Engineer/Architect’s approval before relocating tendons that interfere with one another.
2. Slight deviations in horizontal spacing and location are permitted when required to avoid openings and inserts.
3. Maintain minimum radius of curvature of 21 feet for horizontal deviations.
4. Locate tendons parallel to grid lines unless otherwise noted.
5. Straighten strands to produce equal stress in all tendons that are to be stressed in a concrete placement and to ensure proper positioning of anchors.

D. Anchors:

1. Install anchors perpendicular to tendon axis.
2. Install tendons straight, without vertical or horizontal curvature, for a minimum of 12 inches behind stressing-end and intermediate anchors.
3. Attach stressing-end anchors securely to bulkhead forms to prevent loosening due to construction activity or during concrete placement.

E. Tendon Bundling:

1. Limit slab tendon bundles to two tendons.
2. Do not twist or entwine tendons within a bundle.

F. Tendon Protection:

1. Protect tendons from moisture and corrosion prior to concrete placement.
2. Protect exposed tendons from moisture and corrosion at all times.
3. Bare tendons are not permitted at any time.
4. Do not cut or remove sheathing before concrete is placed.

G. Over occupied/finished areas permanently mark tendon locations on slab soffit.
H. Do not use splices or coupler assemblies within a concrete pour unless accepted in writing by the Engineer. When coupler assemblies are used, completely fill enclosure with corrosion inhibiting coating.

I. Welding is prohibited unless shown on the drawings or accepted in writing by the Engineer.

3.3 SHEATHING INSPECTION AND REPAIR

A. Inspect sheathing for damage after installing tendons and before placing concrete.

B. Remove and replace tendons that have damaged encapsulation systems including sheathing tears or cuts over 10 percent of the length (damage need not be continuous), sheathing withdrawn from connecting sleeves, or connecting sleeves withdrawn from fixed end anchorages.

C. Repair damaged areas by restoring corrosion inhibiting coating and repairing sheathing according to the following procedure to the satisfaction of the Engineer/Architect.

1. Coat with corrosion inhibiting coating outside of sheathing for the length of damaged area plus 2 inches beyond each end of damage. For example, if sheathing tear is 6 inches long then corrosion inhibiting coated area will be 10 inches long, centered on tear.

2. Install longitudinally slit sheathing around corrosion inhibiting coating area with the slit on the side opposite the tear. Extend slit sheathing 2 inches beyond corrosion inhibiting coating area at each end. For example, if corrosion inhibiting coating area is 10 inches long, then the slit sheathing will be 14 inches long, centered on tear.

3. After removing corrosion inhibiting coating from the area to be taped, spirally wrap tape around slit sheathing to provide at least 2 layers of tape. Extend tape 2 inches beyond slit sheathing at each end. For example, if slit sheathing is 14 inches long, then taped area will be 18 inches long, centered on tear.

D. Repair nick and cuts less than 0.25 inches long with sheathing repair material.

3.4 TENDON STRESSING

A. Calibrate stressing jacks and gages at least every 6 months and keep copies of certificates on site and available for inspection.

B. Use stressing jacks that are equipped with pressure gages to permit stress in the tendon to be computed at any time.

C. Begin stressing operations as soon as concrete strength reaches 3,000 psi.

D. Complete stressing within 96 hours after concrete placement begins unless concrete has not reached the required strength. If concrete strength has not reached minimum stressing strength within 96 hours (including weekends and holidays) apply 50 percent stress to each tendon and full stress as soon as compressive strength reaches the minimum stressing strength.

E. If measured elongation deviates from calculated elongation by more than 7 percent, recalculate elongations based on actual modulus of elasticity of strand.
F. If, after modulus check, measured and calculated elongations still deviate by more than 7 percent, cease stressing operations. Review section 7.3 from PTI’s “Field Procedures Manual for Unbonded Single Strand Tendons” for causes for improper elongation. Proceed with stressing only after deviation cause has been determined and corrected to satisfaction of Engineer/Architect.

G. Do not allow tendon movement greater than 0.25 inches during wedge seating.

3.5 TENDON FINISHING

A. Do not cut tendons or cover anchorages until stressing records reviewed and accepted by Engineer/Architect.

B. Clean tendons, anchorages and pockets of corrosion inhibiting prior to cutting tendons.

C. Cut tendon end between 0.5 inches and 0.75 inches from wedges. Leave tendon end clean and free of burrs. Use one of the following methods:

1. Plasma cutting.
2. Hydraulic shears.
3. Oxyacetylene flame, allowed only after a successful mockup demonstrating that the encapsulation system is not compromised.

D. Make tendon ends accessible for inspection prior to and during cutting and grouting.

E. Do not damage tendon, anchorage or concrete during the cutting and removal of the tendon.

F. For encapsulated systems, cut tendon and install watertight cap with grease no more than 8 hours after acceptance of stressing records.

G. Install a watertight assembly no more than 24 hours after stressing operations at the exposed stressing length of the intermediate anchorages.

H. Coat pocket surface with bonding agent after sealing tendon end and wedges and before grouting tendon pocket.

I. Grout tendon pockets no more than 24 hours after acceptance of stressing records. Finish grout flush with adjacent concrete.

3.6 FIELD QUALITY CONTROL

A. Engage a qualified testing agency approved by Engineer/Architect to perform tests and inspections. Testing agency has authority to reject work not conforming to the Contract Documents.

B. Before concrete placement, testing agency will inspect the following for compliance with the Contract Documents and accepted Installation Drawings.

1. Location and number of tendons.
2. Tendon size and grade.
3. Tendon profile and cover.
4. Sheathing type, thickness, damage and repair.
5. Corrosion inhibiting coating.
6. Anchorages, sleeves and accessories.
7. Support methods.
8. Encapsulation system.

C. During stressing operations testing agency will record the following and promptly submit to Engineer/Architect upon completion of stressing operations each day.

1. Calculated tendon elongation based on actual modulus of elasticity and cross-sectional area of tendons used.
2. Actual elongation measured for each tendon.
3. Gage pressure required to achieve required stressing force (per calibration chart) for each tendon.
4. Actual gage pressure for each tendon.
5. Required concrete strength at time of stressing.
6. Reported concrete strength at time of stressing.
7. Range of allowable elongations for stressing force.
8. Jack and gage identification numbers.
9. Installer certification that stressing process and records have been reviewed and that forces specified have been provided.

D. After stressing operations testing agency will inspect the following for compliance with the Contract Documents.

1. Tendon cutting.
2. Tendon end length.
3. Anchor caps with grease.
4. Cleaning and grouting of pockets.

E. Testing agency will prepare test and inspections reports in an accepted format. In addition to test and inspection data, include the following.

1. Project name and location.
2. Date and time of inspection.
3. Inspection location within the structure.
4. Air temperatures, weather and wind speed.
5. Testing agency’s name, address and phone number.
6. Testing agency’s technician’s name.
7. Installer’s name.

3.7 REPAIRS

A. Submit repair procedures to Engineer/Architect for acceptance prior to starting repairs.

B. Complete all required repairs at no cost to Owner.

END OF SECTION 03 38 16
SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Prefabricated building columns.
   3. Field-installed shear connectors.

B. Related Requirements:
   1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
   2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
   3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

D. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.
1.4  COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5  PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6  ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Laboratory Test Reports for Credit IEQ 4.2: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

5. Identify members and connections of the Seismic-Load-Resisting System.

6. Indicate locations and dimensions of protected zones.

7. Identify demand critical welds.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).

2. Electrode manufacturer and trade name, for demand critical welds.
1.7  INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer fabricator.
B. Welding certificates.
C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
D. Mill test reports for structural steel, including chemical and physical properties.
E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength, bolt-nut-washer assemblies.
   4. Shop primers.
F. Survey of existing conditions.
G. Source quality-control reports.
H. Field quality-control and special inspection reports.

1.8  QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
D. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 341 and AISC 341s1.
   3. AISC 360.
   4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles, M-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

   1. Weight Class: Standard.
   2. Finish: Black.

G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

   1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
B. Headed Anchor Rods: ASTM F 1554, Grade 36 ASTM F 1554, Grade 55, weldable, straight.
   3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.

C. Threaded Rods: ASTM A 36/A 36M.
   2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
   3. Finish: Plain.

2.3 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

C. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

D. Primer: SSPC-Paint 25 BCS, Type I, zinc oxide, alkyd, linseed oil primer.

E. Primer: SSPC-Paint 23, latex primer.

F. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

G. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning." SSPC-SP 3, "Power Tool Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
5. Surfaces enclosed in interior construction.
B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

   1. Joint Type: Slip critical.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials and inspect welds.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200
SECTION 05 16 17 - STRAND GUARDRAIL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY
   A. This Section includes the following metal fabrications:
      1. Strand guardrail.
   B. Related Sections: Following Sections contain requirements that relate to this Section:
      1. Division 05 Section "Structural Steel" for structural steel framing system components.

1.3 SUBMITTALS
   A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
   B. Shop drawings detailing fabrication and installation of strand guardrail system. Include plans, elevations, sections, and details of fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts.
   C. Installation drawings shall include:
      1. Number, arrangement, and length of strand guardrails.
      2. Jacking force required to achieve specified final effective force for all strand guardrails.
      3. Cable elongations corresponding to jacking force and final effective force for all strand guardrails.
      4. Detailing of anchorage devices.
      5. Other incidental features.
   D. Submit following information with Installation Drawing submittal:
      1. Sealed calculations, prepared under supervision of a Professional Engineer licensed in Montana for jacking force required to achieve specified final effective strand pretension for all strand guardrails considering strand length, losses due to anchorage seating, and materials and equipment being supplied.
      2. Certified calibration curve for each jack to show the gauge pressure corresponding to the required jacking force.
   E. Samples representative of materials and finished products as may be requested by Engineer/Architect.
F. Qualification data for firms and persons specified in the "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of architects and owners, and other information specified.

G. Stressing records to Engineer/Architect promptly upon completion of stressing operations.

H. Certification from Installer that stressing process and records have been reviewed, and that forces specified have been provided.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing guardrail strand fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

B. Provide barrier cable systems produced in PTI-certified plant conforming to all material and installation requirements of PTI "Specifications for Seven Wire Strand Barrier Cable Applications".

C. Installer Qualifications: All barrier cable systems using seven-wire prestressing steel strands shall be installed by PTI certified installers.

D. Work shall conform to requirements of PTI "Specifications for Seven Wire Strand Barrier Cable Applications" except where more stringent requirements are shown on Drawings or specified in this Section.

E. Inspection Agency, employed by Owner shall keep barrier cable stressing records and submit to Engineer/Architect. Report will document:
   1. Calculated elongation, based upon actual elastic modulus and cross sectional area of strands used.
   2. Actual field elongation measured for each guardrail strand.
   3. Gauge pressure required to achieve required jacking force [per calibration chart] for each strand.
   4. Actual gage pressures for each strand.
   5. Jack and gauge identification numbers.

1.5 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. AISC, "Code of Standard Practice for Steel Buildings and Bridges."
   2. AISC, "Manual of Steel Construction."

B. American Society for Testing and Materials (ASTM):
   1. ASTM A36, "Specification for Structural Steel."
3. ASTM A164, "Specification for Electrodeposited Coatings of Zinc on Steel."
4. ASTM A386, "Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products."
5. ASTM A416, "Specification for Steel Strand, Uncoated Seven-Wire Stress-Relieved, for Prestressed Concrete."
7. ASTM A882, "Standard Specification for Epoxy-Coated Seven-Wire Prestressing Steel Strand."

C. Post-Tensioning Institute

1. “Specification for Seven Wire Strand Barrier Cable Applications.”

1.6 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which strand guardrails must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. General: Comply with Post-Tensioning Institute’s “Specification for Seven Wire Steel Strand Barrier Cable Applications.”

B. Guardrail Strand and Prestressing/Post-Tensioning Anchors:

1. Seven wire, steel strand, 0.5 in. diameter, galvanized stress-relieved prestressing strand, with minimum ultimate tensile strength of 250,000 psi.
2. Strand to have continuous hot-dip galvanized coating. Minimum weight of zinc coating shall be 0.90 oz./sq. ft.(Class A).
4. Anchor back seating force. Unless noted otherwise, back seat all anchors to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.

2.2 FABRICATION, GENERAL

A. Form strand guardrail from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated
or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure strand guardrails rigidly in place and to support indicated loads.

C. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

D. Fabricate joints that will be exposed to weather in a manner to exclude water.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchor bodies where necessary for securing miscellaneous metal fabrications to in-place construction.

B. If the guardrail strands are required to be post-tensioned:
   1. Backstress all fixed and stressing anchorages.
   2. Stress, and then immediately backstress, individual guardrail strands one at a time.
   3. Backstress the guardrail strand to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.
   4. Prevent damage to the column or other member to which the guardrail strand is anchored.
   5. For related procedures refer to the PTI Guide Specification.

C. Do not cut strand ends until Contractor receives Engineer/Architect's written approval of stressing records.

3.3 ADJUSTING AND CLEANING

A. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05 16 17

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SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roof deck.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   2. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.
C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   3. CMC Joist & Deck.
   5. Cordeck.
   6. DACS, Inc.
   8. Marlyn Steel Decks, Inc.
   9. New Millennium Building Systems, LLC.
  11. Roof Deck, Inc.
  12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
  14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
   

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), zinc coating.

3. Deck Profile: As indicated.

4. Profile Depth: As indicated 1-1/2 inches (38 mm).

5. Design Uncoated-Steel Thickness: As indicated.

6. Span Condition: As indicated Triple span or more.

7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.2 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

G. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer’s written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer’s written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal. Unless noted otherwise
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, as indicated or as indicated below

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.
D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor’s expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100
SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Roof rafter framing.
B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of cold-formed steel framing product and accessory.
B. LEED Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
C. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For testing agency.
B. Welding certificates.
C. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.5 QUALITY ASSURANCE
A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AllSteel & Gypsum Products, Inc.
2. California Expanded Metal Products Company.
3. ClarkWestern Building Systems, Inc.
4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Mfg., Inc.
6. Custom Stud Inc.
7. Design Shapes in Steel.
8. Dietrich Metal Framing; a Worthington Industries Company.
10. MarinoWARE.
11. Nuconsteel; a Nucor Company.
12. Olmar Supply, Inc.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Southeastern Stud & Components, Inc.
16. State Building Products, Inc.
19. Steel Structural Systems.
20. Steeler, Inc.
22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

2.3 ROOF-RAFTER FRAMING
A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: As indicated.
   2. Flange Width: 1-5/8 inches (41 mm), minimum.
   3. Section Properties: As indicated.

2.4 FRAMING ACCESSORIES
A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Joist hangers and end closures.

2.5 ANCHORS, CLIPS, AND FASTENERS
A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
D. Welding Electrodes: Comply with AWS standards.
2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI’s specifications and standards, manufacturer's written instructions, and requirements in this Section.

   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer’s written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 “Thermal Insulation,” in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
3.3 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
   1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
   2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

F. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

G. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
3.5 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000
SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Elevator pit sump covers.
3. Miscellaneous steel trim.
4. Metal bollards.
5. Wire rope parking garage guards.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Sustainable Design Submittals:

1. **Product Data:** For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

D. Samples for Verification: For each type and finish of extruded nosing and tread.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. **Recycled Content of Steel Products**: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

F. Zinc-Coated Steel Wire Rope: ASTM A 741.

1. **Wire-Rope Fittings**: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, **ASTM F 593 (ASTM F 738M)**, and nuts, **ASTM F 594 (ASTM F 836M)**.

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize all exterior miscellaneous steel trim.
2.8 METAL BOLLARDS

A. Fabricate metal bollards from steel shapes, as indicated.
   1. Cap bollards as detailed.

B. Fabricate bollards as detailed.

C. Fabricate sleeves for bollard anchorage from steel [pipe] [or] [tubing] with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve.

D. Galvanize all bollards.

2.9 WIRE ROPE PARKING GARAGE GUARDS

A. Wire Rope Parking Garage Guards: 3/4-inch- (19-mm-) diameter, zinc-coated steel wire ropes with wire rope fittings for securing to parking garage columns and walls and for tightening wire rope. See Section 051617 Guard Rail Strand.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize all exterior steel and iron items to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with primers specified in Section 099113 "Exterior Painting" unless indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

E.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in concrete as detailed. Fill annular space around bollard solidly with nonshrink grout.

C. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

D. Fill bollards solidly with concrete, mounding top surface to shed water.
3.3 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000
SECTION 055119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes industrial-type, straight-run stairs with steel-grating treads and railings attached to metal grating stairs.

1.2 ACTION SUBMITTALS
   A. Product Data: For metal grating stairs.
   B. Sustainable Design Submittals:
      1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   C. Shop Drawings: Include plans, elevations, sections, details, and attachments.
   D. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
      1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
      2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
      3. Uniform and concentrated loads need not be assumed to act concurrently.
      4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   B. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
      1. Component Importance Factor: 1.5.

2.2 METALS
   A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

E. Wire Rod for Grating Crossbars: ASTM A 510 (ASTM A 510M).

F. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

2.3 FASTENERS

A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

2.4 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

B. Shop Primers: Provide primers that comply with Section 099113 Exterior Painting.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

B. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Weld exposed corners and seams continuously unless otherwise indicated.

5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

C. Fabricate joints that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
2.6 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:
   1. Fabricate stringers of steel channels.
   a. Provide closures for exposed ends of channel stringers.
   2. Construct platforms of steel channel headers and miscellaneous framing members as indicated.
   3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
   1. Fabricate treads and platforms from welded steel grating with openings in gratings no more than 1/2 inch (12 mm) in least dimension.
   2. Surface: Serrated.
   3. Finish: Galvanized.
   4. Fabricate grating treads with cast-abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.7 STAIR RAILINGS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."
   1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
   2. Connect posts to stair framing by direct welding unless otherwise indicated.

2.8 FINISHES

A. Finish metal stairs after assembly. Stringers, headers, and railings to be prime painted; treads to be galvanized.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 055119
SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Steel pipe railings.
   B. Related Requirements:
      1. Section 055119 "Metal Grating Stairs."

1.2 ACTION SUBMITTALS
   A. Product Data: For the following:
      1. Railing brackets.
      2. Grout, anchoring cement, and paint products.
   B. Sustainable Design Submittals:
      1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
   C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   D. Samples: For each type of exposed finish required.

1.3 INFORMATIONAL SUBMITTALS
   A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
   B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
      1. Handrails and Top Rails of Guards:
2. PIPE AND TUBE RAILINGS

2.1. PIPE AND TUBE RAILINGS

- Uniform load of 50 lbf/ft (0.73 kN/m) applied in any direction.
- Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- Uniform and concentrated loads need not be assumed to act concurrently.

2.2. Infill of Guards:

- Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3. STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide prime painted finish for all installations.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4. FASTENERS

A. General: Provide the following:

1. Ungalvanized Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM 1941M), Class Fe/Zn 5 for zinc coating.

B. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099113 “Exterior Painting.”

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Form changes in direction by bending or by inserting prefabricated elbow fittings.

F. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

G. Close exposed ends of railing members with prefabricated end fittings.

H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.7 STEEL AND IRON FINISHES

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

3.3 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Attach railing posts to stair framing by direct welding where indicated.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

END OF SECTION 055213
SECTION 07 18 00 – TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings”
2. Division 07 Section, “Water Repellents”
3. Division 07 Section, “Concrete Joint Sealants”
4. Division 07 Section, “Expansion Joint Assemblies”

B. This Section includes traffic topping: Fluid applied, waterproofing, traffic-bearing elastomeric membrane with integral wearing surface, where the surface to which membrane is to be applied is one or more of the following:

1. Over enclosed rooms:
   a. Electrical/mechanical rooms
   b. Storage room

C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

D. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 03 Section, "Cast-in-Place Concrete."
2. Division 07 Section, “Water Repellents”
3. Division 07 Section, “Concrete Joint Sealants”
4. Division 07 Section, “Expansion Joint Assemblies”
5. Division 09 Section, “Pavement Markings.”

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.
B. Pre-installation Conference: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful topping performance. Require every party concerned with topping Work, or required to coordinate with it or protect it thereafter, to attend. Include manufacturer’s technical representative and warranty officer.

C. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures:”


1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate
3. Material, and wet mils required to obtain specified dry thickness for each coat.
4. Type, gradation and aggregate loading required within each coat.

B. Samples:

1. One 4 in. by 4 in. stepped sample showing each component for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of Colorado, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator’s being certified by manufacturer. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims.
3. Certification from the Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic topping.
4. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).
5. Certification stating materials have been tested and listed for UL 790 Class “A” rated materials/system by UL for traffic topping application specified on project. Containers shall bear UL labels.
6. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.

B. Manufacturer’s Instructions: for each system indicated.
1. Crack treatment and surface preparation method and acceptance criteria.
2. Method of application of each coat.
3. Maximum and minimum allowable times between coats.
4. Final cure time before resumption of parking and/or paint striping.
5. Any other special instructions required to ensure proper installation.

C. Field Quality Control:

1. Quality Control Plan as defined in Part 3.
2. Two copies each of manufacturer’s technical representative’s log for each visit.
3. Testing agency field reports.

D. Qualification Statements

1. Manufacturer’s qualifications as defined in the “Quality Assurance” article.
2. Installer’s qualifications as defined in the “Quality Assurance” article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.
B. Five copies of snow removal guidelines for areas covered by Warranty.
C. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:
   a. Name and location of project.
   b. Type of system applied.
   c. On-Site contact with phone number.

B. Manufacturer’s technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer’s Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of compliance with Summary article paragraph "A single installer. . .”
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer’s superintendent.

D. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer/Architect.

E. Certifications

2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Montana.
3. Licensing/certification agreement shall include following information:
   a. Applicator’s financial responsibility for warranty burden under agreement terms.
   b. Manufacturer’s financial responsibility for warranty burden under agreement terms.
   c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
   d. Authorized signatures for both Applicator Company and Manufacturer.
   e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:
   1. Name of product.
   2. Name of manufacturer.
   3. Date of preparation.
   4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY
A. System Manufacturer (New Application): Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). The warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Spalling surfaces.
3. Weathering.
4. Surface crazing (does not apply to traffic topping protection course).
5. Abrasion or tear failure resulting from normal traffic use.
6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic topping installation on double tees only.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty — if any - based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

F. Snowplows, vandalism, studded snow tires, and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. BASF Building Systems (BASF), Shakopee, MN
2. Lymtal International Inc. (Lymtal), Lake Orion, MI.
3. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
4. Pecora Corporation (Pecora), Harleysville, PA
5. Sika Corporation (Sika), Lyndhurst, NJ.
6. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, TRAFFIC TOPPING

A. Acceptable low odor toppings are listed below. One will be selected as an alternate. In bid form, list bid price for each topping listed below. Contract for topping will not necessarily be
directed to lowest bid priced topping. Toppings shall be compatible with all other materials in
this Section and related work.

1. Heavy Duty:
   b. Iso-Flex 750U-HL HVT/760U-HL HVT Deck Coating System, LymTal.
   c. MasterSeal Traffic 1500, BASF.
   d. Sikalastic 710/715, Sika.

B. Provide ultraviolet screening for all traffic topping placed on this project.

C. Finish top coat shall be colored grey.

D. Substitutions: None for this project. Contact Engineer/Architect for consideration for future
projects.

2.3 MATERIALS, CRACK SEALER

A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:
   1. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.
   2. MasterSeal 630, BASF.
   4. SikaPronto 19TF, Sika.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer any
deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface
preparation and application:

   1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high
      points, ridges, and other defects in a manner acceptable to the Engineer.
   2. Curing compounds used on concrete surfaces are compatible with system to be installed.
   3. Concrete surfaces have completed proper curing period for system selected.
   4. Joint Sealants are compatible with traffic toppings.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from
infiltration. All protective measures and/or ventilating systems required to prevent infiltration are
incidental to this Work.
B. Acid etching is prohibited.

C. Remove all laitance and surface contaminants, including oil, grease and dirt by shotblasting. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.

D. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants and dry properly and to evaluate appearance.

E. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.

F. Over banding of all sealants with manufacturer's recommended base coat is required prior to base coat application.

G. Mask off adjoining surfaces not to receive traffic topping and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic topping.

3.3 INSTALLATION/APPLICATION

A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.

B. A primer coat is required for all systems. No exception.

C. Do not apply traffic topping material until concrete has been air dried at temperatures at or above 40ºF. for at least 30 days after curing period specified.

D. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

E. All adjacent vertical surfaces shall be coated with traffic topping minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.

F. Complete all Work under this Section before painting line stripes.

G. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during
application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.

C. Install 1 trial section of topping system for each duty grade specified. Do not proceed with further topping application until trial sections accepted in writing by Engineer/Architect. Remove and replace rejected trial sections with acceptable application. Trial section shall also be tested for:

1. Wet mil thickness application.
2. Adhesion to concrete substrate.
3. Overall dry mil thickness.

D. Use trial sections to determine adequacy of pre-application surface cleaning. Obtain Engineer and manufacturer acceptance of cleaning before proceeding with topping application.

E. Determine overall topping system mil thickness:

1. Contractor shall provide 6 in. by 6 in. bond breaker (topping coupon) on concrete surface for each 25,000 sq ft, or fraction thereof, of topping to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
2. Contractor shall assist Testing Agency in removing topping coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per topping manufacturer's instructions.
3. Testing Agency shall determine dry mil thickness of completed Traffic Topping System, including bond breaker. Take 9 readings (minimum), 3 by 3 pattern at 2 in. on center. No reading shall be taken closer than 1 in. from coupon edge. Report individual readings and overall topping system average to Engineer/Architect. Readings shall be made with micrometer or optical comparator.
SECTION 07 19 00 – WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 03 Section, “Cast-In-Place Concrete”
2. Division 07 Section, “Traffic Coatings”
3. Division 07 Section, “Concrete Joint Sealants”
4. Division 07 Section, “Expansion Joint Assemblies”

B. This Section includes penetrating concrete sealer on these surfaces:

1. Supported concrete floor and concrete roof surfaces including curbs, walks, islands and pour strips.
2. Concrete stair treads and landings.
3. Slab-on-grade within parking facility, including curbs, walks, and islands.
4. Approach drives and adjoining sidewalks within construction limits.

C. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 03 Section, “Cast-in-Place Concrete”
2. Division 07 Section, “Traffic Coatings”
3. Division 07 Section, “Concrete Joint Sealants”
4. Division 07 Section, “Expansion Joint Assemblies”
5. Division 09 Section, “Pavement Markings.”

1.3 REFERENCES

A. ASTM International (ASTM):


1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

WATER REPELLENTS
1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.

B. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures.”

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated at least 60 days prior to application.
1. Product description, technical data, appropriate applications, and limitations.
2. Areas and application rates of materials to be applied.
3. Proposed alternate application methods, if any.

1.6 INFORMATION SUBMITTALS

A. Certificates
1. Certification that products and installation comply with applicable federal, state of Colorado, and local EPA, OSHA and VOC requirements regarding health and safety hazards.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims.

B. Field Quality Control
1. ASTM D6489 Test Results
2. Two copies of manufacturer's technical representative's log for each visit.

C. Qualification Statements
1. Manufacturer's qualifications as defined in the “Quality Assurance” article.
2. Installer's qualifications as defined in the “Quality Assurance” article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Owner retains right to reject any manufacturer.
1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:
   a. Name and location of project.
   b. Type of system applied.
c. On-Site contact with phone number.

B. Installer’s Qualifications: Owner retains right to reject any installer.
   1. Evidence of compliance with Summary article paragraph "A single installer. . ."
   2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
   3. Listing of 5 or more installations in climate and size similar to this Project performed by installer’s superintendent.

C. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer.

D. Certifications
   2. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Montana
   3. Licensing/certification agreement must provide following information:
      a. Applicator’s financial responsibility for warranty burden under agreement terms.
      b. Manufacturer’s financial responsibility for warranty burden under agreement terms.
      c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
      d. Officers’ signatures for both Applicator Company and Manufacturer.
      e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:
   1. Name of product.
   2. Name of manufacturer.
   3. Date of preparation.
   4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.
1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application (except with written recommendation of manufacturer) under any of the following conditions:

1. Ambient temperature is less than 40º F.
2. Substrate surfaces have cured for less than 1 month.
3. Rain or temperatures below 40º F predicted for a period of 24 hours.
4. Less than 24 hours after surfaces became wet.
5. Substrate is frozen or surface temperature is less than 40º F.
6. Wind velocities higher than manufacturer's specified limit to prevent solvent flash-off.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:

1. Advanced Chemical Technologies Inc. (ACT), Oklahoma City, OK.
2. BASF Building Systems (BASF), Shakopee, MN.
3. Evonik Degussa Corporation (Evonik Degussa), Parsippany, NJ.
4. Lymtal International Inc. (Lymtal), Lake Orion, MI.
5. Sika Corporation (Sika), Lyndhurst, NJ.

2.2 MATERIALS, CONCRETE SEALER

A. Silane (40% solids, 600 g/L or less VOC):

1. MasterProtect H 440 HZ, 125 sf/g, BASF.
2. Iso-flex 618-40 VOC, 125sf/g, Lyntal.
3. Protectosil Chem-Trete 40 VOC, 125 sf/g, Evonik Degussa.
4. Sikagard 740W, 125 sf/g, Sika
5. Sil-Act ATS-42, 125 sf/g, ACT.

B. Proposed substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:

1. SikaPronto 19TF, Sika.
2. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
3. MasterSeal 630, BASF.
4. Denedeck Crack Sealer, Deneef.
5. Iso-Flex 609 Epoxy Crack Sealer, Lyntal.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:
   1. Concrete surface finishes are acceptable for system to be installed.
   2. Curing compounds used on concrete surfaces are compatible with system to be installed.
   3. Concrete surfaces have completed proper curing period for system selected.
   4. Control joint and expansion joint Work is complete and has been accepted by Engineer/Architect.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Acid etching is prohibited.

C. Repair or replace all sealant materials damaged by surface preparation operations.

D. Shot blast clean all surfaces to be sealed as acceptable to sealer manufacturer before sealer application. Shot blasting is not recommended or required for new slabs that are water cured per ACI 308, Paragraph 2.2. Cleaning method and materials shall be sufficient to allow absorption criteria stated in Field Quality Control article to be met. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.

E. Equipment used during floor slab cleaning shall not exceed height limitation of facility and shall not exceed 3,000 lb axle load or vehicle gross weight of 6,000 lb.

F. Mask off adjoining surfaces not to receive sealer and mask off drains to prevent spillage and migration of liquid materials outside sealer area. Provide neat/straight lines at termination of sealer.

3.3 INSTALLATION/APPLICATION

A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverage, mil thickness and texture, and as shown on Drawings.

B. Clean all surfaces affected by sealer material overspray and repair all damage caused by sealer material overspray to adjacent construction or property at no cost to Owner.
C. Clean off excess material as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Install 3 trial sections of sealer to verify treated surface is not glazing as result of sealer application. If application of sealer causes glazing at trial section, contact sealer manufacturer to obtain written recommendations for solving problem. Do not proceed with sealer application following trial section applications until directed to do so in writing by Engineer.

3.5 NON-CONFORMING WORK

A. Unsatisfactory Field Quality Control test results shall be grounds for rejection of sealer or sealer application rate. Perform sealer reapplication at no additional cost to Owner.

END OF SECTION 07 19 00
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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Extruded polystyrene foam-plastic board.
      2. Glass-fiber blanket.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS
   A. Product test reports.
   B. Research reports.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD
   A. Extruded polystyrene boards in this article are also called "XPS boards."
   B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
   C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. DiversiFoam Products.
      2. Dow Chemical Company (The).
      3. Owens Corning.

2.2 GLASS-FIBER BLANKET
   A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
2.3 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Industrial Insulation Group, LLC (IIG-LLC).
2. Roxul Inc.
3. Thermafiber, Inc.; an Owens Corning company.

2.4 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.3 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

END OF SECTION 072100
SECTION 072715 - NONBITUMINOUS SELF-ADHERING SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air-barrier assemblies.
   1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of nonbituminous self-adhering sheet air barrier.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.
   1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
      a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa) <Insert value>, when tested according to ASTM E 2357.

2.2 NONBITUMINOUS SHEET AIR BARRIER

A. Vapor-Permeable Nonbituminous Sheet: Minimum 20-mil- (0.5-mm-) thick, self-adhering sheet consisting of a breathable carrier film or fabric and an adhesive with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cosella-Dorken Products, Inc.
   b. Grace Construction Products; W.R. Grace & Co. -- Conn.
   c. VaproShield LLC.

2. Physical and Performance Properties:
   a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
   b. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E 154/E 154M.
   c. Vapor Permeance: Minimum 15 perms (860 ng/Pa x s x sq. m); ASTM E 96/E 96M, Desiccant Method, Procedure A.
   d. Adhesion to Substrate: Minimum 16 lbf/sq. in. (110 kPa) when tested according to ASTM D 4541 as modified by ABAA.
   e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
   f. UV Resistance: Can be exposed to sunlight for 150 days according to manufacturer's written instructions.

2.3 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

F. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.2 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

D. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

E. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each
substrate. Maintain 3 inches (75 mm) of contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

G. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.

H. Do not cover air barrier until it has been tested and inspected by testing agency.

I. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

END OF SECTION 072715
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY
A. A single installer shall be responsible for providing complete waterproofing system including all products specified in the following Sections:
   1. Division 07 Section, “Traffic Coatings”
   2. Division 07 Section, “Water Repellents”
   3. Division 07 Section, “Concrete Joint Sealants”
   4. Division 07 Section, “Expansion Joint Assemblies”

B. This Section includes the following:
   1. Exterior joints in the following horizontal traffic bearing surfaces:
      b. Control joints in slab-on-grade, pour strips, slabs and topping slabs.
      c. Joints between precast concrete units.
      d. Perimeter of all floor drains.
   2. Exterior joints in the following vertical and horizontal non-traffic surfaces:
      b. Joints between precast concrete units.
      c. Cove joints at intersection of horizontal and vertical concrete.
      e. Vertical and horizontal joints between precast beams and columns at tiers exposed directly to weather. Color to match precast concrete.

C. Related Sections: Following Sections contain requirements that relate to this Section.
   1. Division 01 Section "Submittal Procedures."
   2. Division 03 Section, "Cast-in-Place Concrete."
   3. Division 03 Section "Unbonded Post-Tensioned Concrete."
   4. Division 07 Section "Expansion Joint Assemblies."
   5. Division 07 Section "Water Repellents."
   6. Division 07 Section "Traffic Coatings."
   7. Division 09 Section "Pavement Marking."
1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
   2. Distribute reviewed submittals to all others whose Work is related.
   3. Coordinate layout of joint system and approve methods for providing joints with concrete contractors.

B. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures.”

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.
   1. Product description, technical data, appropriate applications and limitations.
   2. Primer type and application rate

B. Samples:
   1. One for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:
   1. Evidence of installer’s being certified by manufacturer. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims.
   2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

B. Field Quality Control:
   1. Two copies each of manufacturer’s technical representative’s log for each visit.
   2. Testing agency field and test reports.

C. Qualification Statements:
   1. Manufacturer’s qualifications as defined in the “Quality Assurance” article.
   2. Installer’s qualifications as defined in the “Quality Assurance” article.
   3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.
1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Five copies of snow removal guidelines for areas covered by Warranty.

C. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.
   1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
   2. Evidence of financial stability acceptable to Engineer/Architect.
   3. Listing of 20 or more projects completed with submitted system, to include:
      a. Name and location of project.
      b. Type of system applied.
      c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any installer or subcontractor.
   1. Installer shall be legally licensed to perform work in the state of Montana. Evidence of compliance with Summary article paragraph "A single installer. . ."
   2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
   3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer.

E. Certifications:
   1. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer
   2. Licensing/certification agreement shall include following information:
      a. Applicator's financial responsibility for warranty burden under agreement terms.
      b. Manufacturer's financial responsibility for warranty burden under agreement terms.
      c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
      d. Authorized signatures for both Applicator Company and Manufacturer.
      e. Commencement date of agreement and expiration date (if applicable).
1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

A. System Manufacturer and Contractor shall furnish Owner written single source performance guarantee that the joint sealant system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Weathering.
3. Abrasion or tear failure resulting from normal traffic use.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year period commencing with date of acceptance of work.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

F. Snowplows, vandalism, and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.
PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only
      where specifically named in product category:
      1. BASF Building Systems (BASF), Shakopee, MN.
      2. Dow Corning Corp. (Dow Corning), Midland, MI.
      3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
      4. Pecora Corporation (Pecora), Harleysville, PA.
      5. Sika Corporation (Sika), North Canton, OH.
      6. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM
   A. Provide complete system of compatible materials designed by manufacturer to produce
      waterproof, traffic-bearing control joints as detailed on Drawings.
   B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented
      compounds not acceptable.
   C. Color of sealants shall match adjacent surfaces.
   D. Closed cell or reticulated backer rods: Acceptable products:
      2. “ITP Soft Type Backer Rod,” Industrial Thermo Polymers Limited, 2316 Delaware Ave.,
         Suite 216, Buffalo, NY 14216.  (800) 387-3847.
      3. “MasterSeal 921 Backer Rod,” BASF.
   E. Bond breakers and fillers: as recommended by system manufacturer.
   F. Primers: as recommended by sealant manufacturer.
   G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in
      this Section and related work.
   H. Acceptable polyurethane control joint sealants (traffic bearing):
      1. MasterSeal SL-2 or MasterSeal SL-2 SG, BASF.
      2. Iso-flex 880 GB or Iso-flex 881, Lymtal.
      3. Dynatrol II-SG or Urexpan NR 200, Pecora.
      4. Sikaflex-2c SL or Sikaflex-2c NS TG, Sika.
      5. THC-900, THC-901, Vulkem 45SSL, Dymeric 240, Dymeric 240 FC or Dymonic 100,
         Tremco.
   I. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):
      1. Sikaflex-2c NS, Sika.
2. MasterSeal NP-2, BASF.
3. Dymeric 240/240FC, Dymonic 100 or THC 901 (cove only), Tremco.
4. Dynatred, Pecora.
5. Iso-flex 881, Lyntal.

J. Proposed Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning installation

   1. Concrete surfaces are finished as acceptable for system to be installed.
   2. Curing compounds used on concrete surfaces are compatible with system to be installed.
   3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Correct unsatisfactory conditions before installing sealant system.

C. Acid etching is prohibited.

D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.

E. Final preparation of joints shall be a sandblast with medium that removes dust and ground material from surfaces to receive sealant.

F. Check preparation of substrate for adhesion of sealant.

G. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.
3.3 INSTALLATION/APPLICATION

A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), thicknesses and texture, and as shown on Drawings.

B. Completely fill joint without sagging or smearing onto adjacent surfaces.

C. Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.

D. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40°F.

3.4 FIELD QUALITY CONTROL

A. Contractor and Engineer will jointly determine which one of following 2 methods of sealant testing to verify sealant profile:

1. Contractor, at Engineer's direction, shall cut out lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer and Manufacturer's Representative inspection of sealant profile.

2. Contractor, at Engineer's direction, shall install 3 trial joint sections of 20 ft each. Contractor shall cut out joint sections, as selected by Engineer, for Engineer and Manufacturer's Representative inspection. Additional isolated/random removals may be required where sealant appears deficient. Total cut out sealant shall not exceed lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer and Manufacturer's Representative inspection of sealant profile.

B. Repair all random joint sealant "cut out" sections at no cost to Owner.

C. Testing Agency:

1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.

2. If flood test of joints required by this Section, report results to Engineer.

END OF SECTION 07 92 33

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SECTION 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes interior expansion joint cover assemblies.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Shop Drawings: For each expansion joint cover assembly.
      1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams and a tabular schedule of expansion joint cover assemblies.
   C. Samples: For each expansion joint cover assembly and for each color and texture specified.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION
   A. Furnish units in longest practicable lengths to minimize field splicing.
   B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS
   A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   B. Expansion Joint Design Criteria:
      1. Type of Movement: Wind sway.
         a. Nominal Joint Width: As indicated on Drawings.
         b. Minimum Joint Width: As indicated on Drawings.
         c. Maximum Joint Width: As indicated on Drawings.
      2. Type of Movement: Seismic.
         a. Joint Movement: As indicated on Drawings.
2.3 FLOOR EXPANSION JOINT COVERS

A. Metal-Plate Floor Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.

1. **Basis** of Design: MM Systems, Model # SSP-C-600, or approved equal.
2. **Application**: Floor to floor.
3. **Installation**: Surface mounted.
4. **Load Capacity**:
   a. Uniform Load: 50 lb/sq. ft. (244 kg/sq. m).
   b. Concentrated Load: 300 lb (136 kg).
   c. Maximum Deflection: 0.0625 inch (1.6 mm).
5. **Cover-Plate Design**: Abrasive covered.
6. **Exposed Metal**:
   a. Aluminum: Clear anodic, Class I.

2.4 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.

B. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M.

2.5 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.

1. **Provide where indicated on Drawings**.

B. Manufacturer's standard attachment devices, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies.

C. Comply with manufacturer’s written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

D. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
   1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
   2. Install frames in continuous contact with adjacent surfaces.
      a. Shimming is not permitted.
   3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
   4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
   5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
   6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

E. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

F. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.2 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.13
SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Adhered polyvinyl-chloride (PVC) roofing system.
   2. Roof insulation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA’s "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For the following products:
   1. Sheet roofing, of color required.

1.5 INFORMATIONAL SUBMITTALS

A. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.
1.7 QUALITY ASSURANCE
   A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 WARRANTY
   A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Source Limitations: Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS
   A. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
   B. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
   C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures: To meet FM-120.
   D. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
   E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
   F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 PVC ROOFING
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle SynTec Incorporated.
   b. GAF Materials Corporation.
   c. GenFlex Roofing Systems.
   e. Sika Sarnafil.
   f. Versico Incorporated.

2. Thickness: 60 mils (1.5 mm), nominal.

2.4 **AUXILIARY ROOFING MATERIALS**

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

F. Miscellaneous Accessories: Provide metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 **ROOF INSULATION**

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Carlisle SynTec Incorporated.
   b. GAF Materials Corporation.
   c. Insulfoam LLC; a Carlisle company.
   e. Rmax, Inc.

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 5/8 inch (16 mm) thick.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation.
      b. Georgia-Pacific Building Products.
      c. National Gypsum Company.
      d. United States Gypsum Company.

2.7 ASPHALT MATERIALS

A. Roofing Asphalt: ASTM D 312, Type III or Type IV.

B. Asphalt Primer: ASTM D 41/D 41M.

PART 3 - EXECUTION

3.1 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.2 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.3 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Install tapered insulation under area of roofing to conform to slopes indicated.

C. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

D. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

E. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

F. Install slip sheet over cover board and immediately beneath roofing.

3.4 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5036.

B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

D. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.
E. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

F. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

### 3.5 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings.

### 3.6 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075419
SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes hollow-metal work.

1.2 DEFINITIONS
A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
C. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
D. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS
A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Amweld International, LLC.
   2. Ceco Door; ASSA ABLOY.
   3. Curries Company; ASSA ABLOY.
   4. Custom Metal Products.
2.2 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. All locations.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches (44.5 mm).
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
      d. Edge Construction: Model 1, Full Flush Model 3, Stile and Rail.
      e. Core: Manufacturer's standard insulation material.
   3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
   4. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
      b. Construction: Full profile welded.

2.3 FRAME ANCHORS

A. Jamb Anchors:
   1. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.4 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTMA 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.5 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer’s plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

4. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.

4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
   b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
   c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
   d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting sections.

END OF SECTION 081113
SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

   A. Section Includes:

      1. Mechanical door hardware for the following:
         a. Swinging doors.
      2. Cylinders for door hardware specified in other Sections.

1.2 PREINSTALLATION MEETINGS

   A. Preinstallation Conference: Conduct conference at Project site.
   B. Keying Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

   A. Product Data: For each type of product.
   B. Shop Drawings: For electrified door hardware.
      1. Include diagrams for power, signal, and control wiring.
      2. Include details of interface of electrified door hardware and building safety and security systems.
   C. Samples: For each exposed product in each finish specified.
   D. Door hardware schedule.
   E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

   A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

   A. Maintenance data.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
   a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled on Drawings.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.
B. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.

C. Lock Trim:
   1. Description: As indicated on Drawings.

D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

E. Mortise Locks: BHMA A156.13; stamped steel case with steel or brass parts; Series 1000.

2.5 SURFACE BOLTS
A. Surface Bolts: BHMA A156.16.

2.6 LOCK CYLINDERS
A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
   1. Core Type: Interchangeable.

2.7 KEYING
A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference per MSU standards.

2.8 ACCESSORIES FOR PAIRS OF DOORS
A. Astragals: BHMA A156.22.

2.9 SURFACE CLOSERS
A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.10 MECHANICAL STOPS AND HOLDERS
A. Wall- and Floor-Mounted Stops: BHMA A156.16.
2.11 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.12 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.13 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

2.14 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

2. Custom Steel Doors and Frames: HMMA 831.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Replace construction cores with permanent cores as directed by Owner.
   2. Furnish permanent cores to Owner for installation.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   1. Do not notch perimeter gasketing to install other surface-applied hardware.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE – See Drawings.

END OF SECTION 087100
SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior partitions.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

B. Studs and Runners: ASTM C 645.
   1. Steel Studs and Runners:
      a. Minimum Base-Metal Thickness: As indicated on Drawings.
      b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:
   1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to runners while allowing 1-1/2-inch (38-mm) minimum vertical movement.
   2. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
   3. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
   4. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: As indicated on Drawings.

E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch-(13-mm) wide flanges.
   1. Depth: As indicated on Drawings.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch-(1.72-mm) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base-Metal Thickness: As indicated on Drawings.
   2. Depth: As indicated on Drawings.

G. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch-(13-mm) wide flanges.
   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-(1.59-mm) diameter wire, or double strand of 0.048-inch-(1.21-mm) diameter wire.

H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

2.2 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
   2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.
G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216
SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Interior gypsum board.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL
   A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD
   A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
      1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         a. CertainTeed Corporation.
         b. Georgia-Pacific Building Products.
         c. National Gypsum Company.
         d. United States Gypsum Company.
      2. Thickness: 5/8 inch (15.9 mm).

2.3 TRIM ACCESSORIES
   A. Interior Trim: ASTM C 1047.
      1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
      2. Shapes:
         a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

E. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."
PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C 840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer’s written instructions.

E. Prefill open joints, rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

3.2 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900
PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Concrete.
   2. Steel and iron.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
B. Samples: For each type of paint system and each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.
   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Sherwin Williams
      2. Benjamin Moore & Co.

2.2 PAINT, GENERAL
   A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
   B. Material Compatibility:
      1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
      2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
   C. Colors: As indicated in the Color and Finish Schedule.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
   B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
      1. Concrete: 12 percent.
   C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
   D. Proceed with coating application only after unsatisfactory conditions have been corrected.
A. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates:

1. High Build Coatings
   a. Primer for Epoxy, Exterior, High Build: As recommended in writing by topcoat manufacturer.
      1) Sherwin Williams: Zinc-clad II Plus, zinc rich three component primer.
   b. Intermediate Coat for Epoxy, Exterior, High Build:
      1) Sherwin Williams: Macropoxy 646-100 Fast Cure Epoxy.
   c. Latex, Exterior Acrylic Polyurethane High Build Topcoat:
      1) Sherwin Williams: Acrolon 218 HS Acrylic Polyurethane, (Gloss Level 5).

END OF SECTION 099113
SECTION 09 91 20 - PAVEMENT MARKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and application of paint systems for the high build, two coat systems for the items of types, patterns, sizes, and colors described in this article.

B. Provide the following systems as shown on Drawings:

1. Parking Stall Stripes.
2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words and other markings.


D. Related Work:

1. Pavement Marking Contractor shall verify compatibility with sealers, joint sealants, caulking and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Provide product data as follows:

1. Manufacturer’s certification that the material complies with standards referenced within this Section.
2. Intended paint use.
3. Pigment type and content.
4. Vehicle type and content.

C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.
1.4 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 degrees F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

A. Provide written 1 year warranty to Owner that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to Owner, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement marking materials shall meet Federal, State and Local environmental standards.

B. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.


D. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

2.2 PAVEMENT MARKING PAINTS:

A. Epoxy paint may be used for all markings, unless noted otherwise on the Drawings. Paint shall be a two-component system consisting of minimum 99 percent solids. The material shall be specifically formulated as a pavement marking material and shall be spray applied at ambient temperatures.

1. The specific paint formulation shall be approved for use on highways by the state and/or local DOT where the project is located.

B. Solvent based paint may be employed for white and yellow pavement markings and shall meet the requirements of MPI #32

C. 100% acrylic waterborne - paint shall be used for white and yellow pavement markings and shall meet requirements of MPI #70.
1. All products shall have performance requirements of Type I and II [and III] of Federal Standard TT-P-1952E.

2. 100% acrylic waterborne paint for special color pavement markings (blue, green, red, black) shall meet requirements of Federal Specification TT-P-1952E. Special color marking materials shall be compatible with the white and yellow pavement markings where they are layered.

2.3 COLOR OF PAINT

A. Color of paint unless noted otherwise on Contract Drawings, shall be white and shall match federal color chip 37925 and daylight directional reflectance (without glass beads) shall not be less than 84% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

B. Paint color for traffic yellow, where shown on Contract Drawings or specified herein, shall match federal color chip No. 33538 commonly referred to as federal highway yellow. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

C. Paint color for blue accessible parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

2.4 BEADS

A. Use Glass Beads (Spheres) in all pavement markings except stall striping lines. Conform to Federal Specification TT-B-1325D, Type I. Broadcast beads into markings at rate not less than 6 lbs. per gallon of paint.

2.5 SILICA SAND

A. Silica Sand, where used, shall be foundry grade silica sand composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C 146. The gradation of silica sand shall meet the paint manufacturer’s recommendation. Sand shall broadcast into markings at rate not less than 6 lbs per gallon of paint.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

D. Striping shall not be placed until full cure of concrete slab and sealer. Concrete surfaces generally require 30 to 90 days @ 70°F or higher. Sealers (other than silane) generally require 14 days @ 70°F or higher. Silane sealers require 24 hrs @ 70°F or higher. Bituminous surfaces generally require 30 days @ 45°F or higher.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Do not paint or finish any surface that is wet or damp.

C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, and incompatible paints and encapsulants.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Lay out all striping on each tier, using dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.

F. Where existing painted pavement markings and/or stripes conflict with new striping layout or must be removed due to installation which does not conform to contract requirements, remove existing paint markings, using care to avoid scarring substrate surface.
   1. Concrete and asphalt surfaces: Material shall be removed by methods acceptable to Engineer/Architect and cause as little damage as possible to surface texture of pavement. Methods, that can provide acceptable results, are grinding and air or shot blasting. Use of chemicals to remove pavement markings prohibited. Collect residue generated by removal of pavement markings and dispose of as required by all applicable laws and regulations. If grinding is used, lightly grind floor surface using wheel mounted floor grinder or similar equipment with positive elevation control of grinder head. For all removal techniques: On test area, demonstrate to Owner acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.
   2. Traffic Topping/Membrane surfaces: Remove existing pavement markings by solvent washing or high-pressure water washing. Submit letter from traffic topping/membrane manufacturer certifying that solvents and/or water pressures are acceptable for this use.
and will not damage material. On test area, demonstrate to Owner acceptable removal of paint material and control of paint removal equipment to prevent substrate scarring.

3. Contractor shall not use paint, bituminous bond coat or other methods of covering markings to obliterate existing pavement markings.

4. Material deposited on pavement as a result of removal shall be removed as work progresses. Accumulation of material, that might interfere with drainage or might constitute a hazard to traffic, prohibited.

5. Curing compounds on new concrete surfaces (less than 1 yr old) shall be removed per existing pavement marking removal requirements prior to installation of new pavement markings.

G. Work Areas:

1. Store, mix and prepare paints only in areas designated by Contractor for that purpose.
2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.

H. Mixing:

1. Do not intermix materials of different character or different manufacturer.
2. Do not thin material except as recommended by manufacturer.

I. Disposal:

1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

A. Apply paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat. At Contractor's option, one coat may be applied before substantial completion, with a second coat delayed for 3-6 months until weather conditions are appropriate and the concrete has cured sufficiently for proper adhesion.

1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).
2. Two coat system total wet mil thickness of 0.018 to 0.025 in (0.457 – 0.635 mm) When Type IVA beads are used.
3. Two coat system total wet mil thickness of 0.015 to 0.018 in (0.381 – 0.457 mm) When Type IVB beads are used.

B. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40º F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.
C. Application of beads and/or silica sand shall coincide with application of paint, but shall be done as separate operation by a suitable dispenser. Sand may be premixed with paint for application to curbs only. Glass beads and silica sand shall adhere to the cured paint or all marking operations shall cease until corrections are made.

D. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

END OF SECTION 09 91 20
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SECTION 10 14 00 – SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes following types of signs:

1. Reflective vehicular directional and information signs (V-Signs).
2. Retroreflective regulatory signs (R-Signs).
3. Non-reflective pedestrian directional and informational signs (PP-Signs).
4. PVC Pipe Clearance Signs (PVC-Signs).
5. Vandal-resistant Signs (VR-Signs).
6. Dimensional Characters (D-Signs).
7. Other code required signs.
8. Site Improvement.

B. Related Sections include following:

1. Division 01 Section “Temporary Facilities & Controls” for temporary project identification signs.
2. Division 09 Sections “Exterior Painting” or “Interior Painting” for painting by others of surfaces to which signs specified herein may be applied. Painting of signs is included in this Section.
3. Division 10 Section “Directories and Bulletin Boards” for building directories.
4. Division 11 for occupancy counting systems which interface with space availability displays as specified herein.
5. Division 14 Section “Elevators” for elevator door jamb markings and “In Case of Fire…” signage.
6. Division 23 Section “Common Work Results for HVAC” for labels, tags, and nameplates for mechanical equipment.
7. Division 26 Section “Common Work Results for Electrical Transmissions, Lighting, and Control Devices” for labels, tags, and nameplates for electrical equipment. (Room destination signage is included herein.)
8. Division 26 Section “Interior Lighting” for illuminated exit signs.
9. See Division 26 Sections for electrical service and connections for electrified and/or illuminated signs and/or letters.

C. Alternates:

1.
1.3 SUBMITTALS

A. General: Submit following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions and installation details.

1. Provide message list, typestyles, graphic elements, including tactile characters and Braille and artwork as shown on drawings, and layout of lettering. Include large scale details of sign layout.
2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
3. Wiring Diagrams from manufacturer of electrified signs for power, signal and control wiring.

D. Samples: Provide following samples of each sign component for verification of compliance with requirements indicated.

1. Samples of each sign material type (V-, R-, PP-, VR-, etc), on not less than 6-in. squares of extrusion, sheet or plate, showing full range of colors to be provided.
2. Dimensional characters and castings: Full size sample showing character, material, texture, finish, color, style and attachment method.
3. Brailled Copy: Sample of ADA compliant sign showing raised image text, brailled copy and colors.

E. Maintenance Data: For signage cleaning and maintenance requirements to be included in maintenance manual.

1.4 QUALITY ASSURANCE

A. Qualifications: Manufacturers: Only pre-approved manufacturers as listed herein allowed. Sign manufacturer shall have completed a minimum of 3 projects in last 3 years with similar materials and methods of manufacture as required for this project.

B. Qualifications: Bidder/Installers: When proposed bidder/installer is not proposed manufacturer of at least 75% of signs on project, Bidder/Installer shall be pre-approved. 3 weeks before bidding, prospective bidders shall submit to Engineer/Architect 2 copies of portfolio containing 3 representative projects successfully completed over 3 years preceding Bid. One of 3 projects shall be prospective bidder's most recently completed project. Portfolio shall contain plans, shop drawings, reference letters, material samples, and color photographs of representative projects. Engineer/Architect will review all submitted portfolios with Owner and will issue list of acceptable sign subcontractors 1 week before Bid date. Qualification for Project will prequalify Bidder for future projects with Engineer/Architect for 1 year from Project Bid date.
C. Where warranties are required, manufacturer and/or installers shall be authorized by the entity providing the warranty.

D. All completed signs shall be free from defects in materials and workmanship and effectively present specified or permitted message under both day and night viewing conditions. Sign faces shall be reasonably smooth, shall exhibit uniform color and brightness over entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or incidental beams of automobile headlamps.

E. Support structures for signs that are free-standing or extending from any exterior surface of the building, including but not limited to the roof level parking signs on cantilever supports, shall be designed by a licensed professional engineer in the State of Montana in accordance with ASCE 7-(latest edition) requirements for wind loads.

F. Regulatory Requirements:
   1. Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected, may include, but not be limited to:
      a. Illuminated Exit Signs: Refer to Division 26.
      b. Permanently Designated Rooms and Spaces: A- Signs.
      c. Fire Doors.
      d. Room Capacity.
      e. Live Load Capacity.
      f. Elevator Signs.
      g. Stairway Identification.
      h. Area of Rescue Assistance Identification.
   2. MUTCD:
      a. Regulatory R- and Warning W- signs shall be fully compliant with all requirements of the Manual on Uniform Traffic Control Devices (MUTCD) except that sign size may be modified due to space constraints.

G. Single-Source Responsibility: For each separate required type of sign as defined herein, obtain signs from a single firm specializing in this type of work so that there will be undivided responsibility for such work.

H. Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated dimensions and profiles may be considered, provided deviations do not change design concept. Burden of proof of equality is on proposer.

I. Coordinate sign placement with structural configuration and lighting location. Before sign installation, arrange meeting with Engineer/Architect and lighting installer at site to review sign placement. Additional compensation not allowed for relocating signs after installation if relocation required due to conflicts with lighting or structure.

J. Trade Names: Do not display manufacturer’s name, trade name, trademarks, or similar markings on exterior or visible surfaces.

K. Sign Quantity Count: Sign Fabricator shall be responsible for determining the final quantity count of all signs, as indicated on the Signage Schedule and Location Plans, prior to fabrication.
L. Provide written 5 year full replacement warranty to Owner that all signage will be free of defects due to workmanship and materials including, but not limited to, fading, peeling, delamination, and installation. With no additional cost to Owner, repair all defects that develop during warranty period and all damage to other Work due to such defects. NOTE: Additional warranties apply to specific sign types and products, as specified herein.

M. Finishes Warranty: Submit five-year written warranty, signed by the Contractor and Installer, warranting that the architectural signage finishes will not develop excessive fading or excessive non-uniformity of color or shade and will not crack, peel, pit or corrode or otherwise fail as a result in defects, within the warranty period, make necessary repairs or replacement at the convenience of the owner or facility’s management.

1. “Excessive Fading”: A change in appearance which is perceptible and objectionable as determined by the Designer when visually compared with the original color range standards.
2. “Excessive Non-Uniformity”: Non-Uniform fading during the period of the guarantee, to the extent that adjacent panels have a color difference greater that the original acceptance range of color.
3. “Will Not Pit or Otherwise Corrode”: No Pitting or other type of corrosion discernible from a distance of 10’-0”, resulting from the natural elements in the atmosphere at the project site.

N. Replacement or Repairs: The owner or facilities management shall have the right to continue use of the defective part until such time that the part is replaced or repaired without loss or inconvenience to the owner or facility’s management. Warranties shall also state that the replaced or repaired part shall have a warranty period equal to the remaining warranty period for the replaced or repaired part plus an additional one year.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting and mounting. Where sizes of signs may be affected by dimensions of surfaces on which they are installed, verify dimensions by field measurement. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.6 COORDINATION

A. For signs to be supported by or anchored to permanent construction, provide installers with specific requirements for anchorage devices. Furnish templates for installation.

1.7 MAINTENANCE

A. Maintenance Instruction: Furnish maintenance manual to instruct the owner or facility’s management personnel in procedures to be followed in cleaning and maintaining the signage. Provide manufacturer’s brochures describing the actual materials used in the Work, including metal alloys and finishes.
1. Include a list of cleaning materials appropriate for continued cleaning of signs. Include written instructions for proper maintenance, service access, replacement procedures, etc. Include recommended methods for removal of residual adhesives from wall surfaces after removal of adhesive mounted signs.

B. Extra Materials: Deliver to the owner or facility's management in manufacturer's original packaging and store at the project site where directed.

1. Furnish one quart of each finish paint color for touch-up purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by other manufacturers specified.

B. Manufacturers: Subject to compliance with requirements specific to this project, accepted manufacturers listed in Part 2 are considered to have been prequalified in conformance with paragraph 1.4.A and B of this section. Acceptable manufacturers include, but are not limited to the following:

1. Manufacturers of panel signs, including V-, R-, W-, PP-, PS-, VR-, D- and EP- signs:
   b. Alcan Composites, Benton, KY.
   c. Allenite, A Division of Allen Marking Products, Inc.
   d. Andco Industries Corp.
   e. APCO Graphics, Inc.
   g. ASI Sign Systems, Inc.
   h. Best Manufacturing Co.
   i. Interstate Highway Sign Corp.
   j. Henry Graphics.
   k. Britten Studios.
   l. Pannier Graphics.
   m. Tapco.
   n. Vomar.
   o. Signs + Decal Corp., Brooklyn, NY

2. Manufacturers of Portable Signs (P-)
   a. WindMaster® Curb Signs
      Marketing Displays International
      Farmington Hills, MI 48331
   b. Plastic Barricade Portable Signs
      Plasticade Products
      Rolling Meadows, IL 60008
   c. Signs + Decal Corp., Brooklyn, NY
3. Manufacturers of Brailled Signs (A-):
   a. Supersine Company.
   b. Jet Signs.
   c. Britten Studios.
   d. Signs + Decal Corp., Brooklyn, NY

4. Manufacturers of TC- and CM-, and DM- signs:
   b. C.J. Hood Co.
   c. Colite Industries, Inc.
   d. Daktronics.
   e. Signal Tech (formerly Howard Industries).
   f. 3M Dynamic Message Signs (formerly American Electronic Sign).

5. Manufacturers of I- and non-illuminated EP- signs:
   a. Andco Industries Corp.
   b. ASI Sign Systems, Inc.
   c. Interstate Highway Sign Company.
   d. Vomar.
   e. Signs + Decal Corp., Brooklyn, NY

2.2 MATERIALS
   A. Graphics:
      1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
      2. Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices. Notations contained within the comments section of the sign schedule indicate additional text required on sign such as street name, etc. Notations contained within parenthesis ( ) in the sign schedule and instructions for logos or symbols that are to be included on the sign, as shown on the design drawings. Refer to the sign schedule for copy, description of signs, and reference to sign types.
      3. Silk screening: Where specified or permitted, silk screening shall be highest quality, with sharp lines, no sawtooths, or uneven ink coverage.
         a. Screens shall be photographically reproduced.
         b. Background ink shall be process inks as recommended by manufacturer of substrate employed.
         c. Ink application through screens: 1 flood pass and 1 print pass. Images: uniform color and ink thickness; free from squeegee marks and lines.
         d. Signs: dry in adequate racks with 2 in. spacing for ample air flow and forced air drying and curing.
         e. Package signs only after they have dried completely per ink manufacturer's time allowances.
f. Where reflective messages are specified or permitted to be reverse silk-screened with a non-reflective, opaque background, the sheeting material shall be 3M Scotchlite Engineer Grade Reflective Sheeting Series 3200 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type II, Section 718.01.

g. Where reflective messages are specified or permitted to be reverse silk-screened with a reflective, transparent background, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3930 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01.

4. Pressure applied graphics:

a. Where pressure-applied graphics applied to a painted background are specified or permitted, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.

b. Where pressure-applied, reflective graphics on an opaque painted background are specified or permitted, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Edges shall be sealed per manufacturer recommendation.

c. Where pressure-applied, reflective graphics on a reflective background are specified or permitted, the sheeting material shall be 3930 Hi Intensity Prismatic or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electronic Cutable Film Series 1170, colors as noted on drawings or equivalent.

d. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by computer-driven processes from 3M Scotchcal Electrocut 7725 film.

e. Where electronically cut letters and symbols are specified, the inside corners shall be rounded using the largest radius consistent with acceptable appearance. Minimum radius shall be 1/8 inch on a 3 inch letter. Use prespacing tape as recommended by manufacturer of sheeting as a carrier for letters, numerals and symbols.

5. Digital Imaging: Where digital imaging for original art and multicolored graphics are specified.

a. Where first surface, reflective graphics are specified, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchlite Plus Sheeting Series 680 using IJ680-10 technology. Image to be protected with 3M recommended graphic protective clear coating. Not to be used for regulatory signs.

b. Where first surface non-reflective graphics are required, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchprint flexible reflective graphic film IJ180-10 technology. Image to be protected with 3M recommended graphic protective clear coating.

c. Where second surface, non-reflective graphics are required, the image shall be produced using 3M Scotchprint Electronic Graphics System using Scotchcal 7725 marking film and lamination.
6. Where specified, dry film transfer shall be produced digitally using computer-driven Dry Thermal Transfer system over 3M high intensity reflective vinyl substrates.

7. All products specified to employ 3M sheeting, films, or other components shall be guaranteed and backed by 3M MCS Warranty or equivalent.

B. Inks and Paints:

1. All inks and paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.

2. All colors for which color match specified shall be approved by Engineer/Architect prior to production.

3. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.


   a. Opaque background for pressure applied graphics: Two part acrylic polyurethane, low gloss. Care shall be taken to provide proper curing so that outgassing does not occur after application of sheeting and/or graphics.

   b. Painted finish on Sintra panels: Types of paints known compatible with Sintra material.

      1) Vinlys
      2) Acrylic Lacquers
      3) Two part polyurethanes
      4) Surface preparation:

         a) Surface to be painted must remain dry, clean and grease free.
         b) Surface to be cleaned with a rag moistened with isopropyl alcohol prior to painting.

      5) Apply with a brush, roller or conventional air spray equipment.
      6) Vinyl and Vinyl/acrylic solvent based Screen printing inks are very compatible.

   c. Painted graphics on steel doors: Refer to Painting specification section 09910.3.6.C. Ferrous metal paint selection for door base. Graphics paint to be compatible with base paint.

   d. Base for painted graphics on concrete, stucco, masonry and concrete masonry units to be prepared per Paint specifications. Graphics two part acrylic polyurethane, low gloss.

   e. High gloss enamel base: Graphics medium to be determined by installer. Primer may be required.

5. Applied color whether ink or paint shall conform to color and accelerated weathering requirements of FP-79 and shall not be removable when tested by Film Adhesion Test and by Film Hardness Test.
C. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.

1. General:
   a. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 0.0625 in. measured diagonally.
   b. The back side and edges of all panel signs shall be painted with acrylic polyurethane, color to match the specified background color.
   c. Edge Condition: Square cut.
   d. Corner Condition: Square cut for all signs except Regulatory and Warning signs. Regulatory and Warning sign corners shall be rounded per MUTCD.

2. Fiberglass reinforced plastic (FRP) panels.
   a. Panels shall be manufactured of clear resin or UV stabilized, acrylic-modified polyester resin reinforced with high solubility, chopped strand fiberglass mat. Glass fibers shall not be readily discernable on sign face. In addition sign shall have a glass content of no less than 28% of total sign weight. FRP panels which outgas and cause bubbling of sheeting will not be accepted. Sign shall meet following:
      1) Ambient temperature range of \(-50^\circ\text{F}\) to \(+300^\circ\text{F}\).
      2) Minimum Barcol hardness of 50, tensile strength of 12,000 psi, compressive strength of 20000 psi and flexural strength of 18000 psi.
      3) Minimum impact strength of 6 ft lbs/in notch with fire resistance of 500 degree F.

3. Aluminum:
   a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish indicated, and with not less than strength and durability properties specified in ASTM B209 for 5005-H15.
   b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
   c. Panels shall be etched, degreased, flat, and free of ragged edges. Radius corners by stamping. All signs of same size shall be totally uniform in size. Surface shall be completely clear of dust and dirt before finishes applied.
   d. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:
      1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
      2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.
e. Fabricate aluminum signs with adequately sized, full-length stiffener members as indicated on Drawings.

4. DiBond (T.M.); or approved equal.
   a. Provide aluminum composite panel, one or both sides platinum white stove-lacquered or one side metallic-aluminum, reverse mill finish.
      1) Outer layers are aluminum, inner core is polyethylene.
   b. Provide sign panels with overall thickness in accordance with the following:
      1) Wall or Column surface mounted signs: 2mm (0.079”).
      2) Overhead signs less than 5'-0” long: 3 mm (0.12”).
      3) Overhead signs greater than 5'-0” long: 4mm (0.16”).
   c. Product shall be compatible with temperature ranges varying from -50°C to +80°C.
   d. Product shall have a minimum modulus of elasticity of 70,000 N/mm².
   e. Product shall have water absorption in % according to Din 53 495-0, 01.
   f. Product shall have linear thermal expansion dimensional change of 2.4 mm/m at 100k temperature difference.
   g. Manufacturer/Supplier – Alcan Composites USA, Inc.
      208 W. 5th Street
      P.O. Box 507
      Benton, KY 42025

5. Sintra (T.M.); or approved equal.
   a. Provide a foamed, closed cell polyvinyl chloride (PVC) product.
   b. Provide sign panels in accordance with the following thicknesses:
      1) Wall or column surface mounted signs: min. 6mm (0.236”).
      2) Overhead signs less than 5'-6” long: min. 13mm (0.512”).
      3) Overhead signs greater than 5'-6” long min 19mm (0.748”).
   c. Foamed PVC panels are NOT to be used in areas exposed to direct sunlight.
   d. Primer and paint used shall be as recommended by the manufacturer. Paint finish shall be an “eggshell” finish.
   e. Material Identification and Information:

<table>
<thead>
<tr>
<th>Material</th>
<th>Percent % by Weight</th>
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<tbody>
<tr>
<td>Polyvinyl Chloride</td>
<td>75-85%</td>
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<tr>
<td>Antimony Trioxide</td>
<td>&lt;3.0%</td>
</tr>
<tr>
<td>Cadmium Compounds</td>
<td>&lt;1.0%</td>
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<tr>
<td>Lead Compounds</td>
<td>&lt;2.0%</td>
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<tr>
<td>Titanium Dioxide</td>
<td>&lt;5.0%</td>
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<tr>
<td>Calcium Carbonate</td>
<td>&lt;5.0%</td>
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<tr>
<td>Other</td>
<td>5-10%</td>
</tr>
<tr>
<td>Melting Point</td>
<td>&gt;350 degrees F.</td>
</tr>
</tbody>
</table>

   f. Manufacturer/Supplier – Alcan Composites USA, Inc.
D. V- Signs: Vehicular signs with reflective graphics and retroreflective message on an opaque background.

1. Base materials:
   a. Aluminum with either reverse silk screened graphics or pressure-applied retroreflective letters.
   b. DiBond with either reverse silk screened graphics or pressure applied retroreflective letters.
   c. Sintra with either reverse silk screened graphics or pressure-applied retroreflective letters.
   d. FRP, but only with painted background and pressure applied retroreflective letters.

2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed.
   a. Pressure applied retroreflective white letters/symbols. Use 3M High Intensity Prismatic White Sheeting 3930.
   b. Silk screened; background inks shall be opaque, with retroreflective message.

E. R- Regulatory and W- Warning vehicular signs with retroreflective graphics and message on a retroreflective background.

1. All regulatory and warning signs to fully comply with MUTCD standards.
2. Base material: Aluminum.
3. R and W signs shall have retroreflective messages and retroreflective background using either silk screening or pressure applied retroreflective letters and symbols.
   b. Sheeting Types I through IX.
   d. The geometric conditions to be used in both test methods are 0/45 or 45/0 circumferential illumination or viewing. The CIE standard illuminant used in computing the colorimetric coordinates shall be D 65.
   e. For fluorescent retroreflective materials ASTM E991 may be used to determine the chromaticity provided that the D65 illumination meets the requirements for E 991.
   f. The following 3M Diamond Grade DG³ Reflective Sheeting materials meet the MUTCD retroreflective requirements:
      1) White – DG³4090
2) Red - DG³ 4092
3) Blue – DG³ 4095
4) Yellow - DG³ 4091
5) Green – DG³ 4097
6) Brown – DG³ 4099
7) Fluorescent Yellow – DG³ 4081
8) Fluorescent Yellow Green – DG³ 4083
9) Fluorescent Orange - DG³ 4084

F. PP- Pedestrian Panel Wayfinding and Directional Signs.

1. Base materials:
   a. Aluminum with either reverse silk screened graphics or pressure-applied letters.
   b. Di-Bond with either reverse silk screened graphics or pressure applied letters.
   c. Sintra with either reverse silk screened graphics or pressure-applied letters.
   d. FRP, but only with painted background and pressure applied letters.

2. Graphics and Copy: Any of the following methods of producing graphics and copy may
   be employed:
   a. Pressure applied non-reflective letters/symbols.
   b. Silk screened over a flat opaque background.
   c. Original art and/or multi-color graphics shall be digitally produced on graphic
      media.

G. PS-Supergraphics, Pedestrian Wayfinding and Directional Signs:

1. Painted Super-Graphics: Where graphics painted directly on walls, doors or other
   surfaces are specified, message template to be:
   a. Pressure applied electronically cut graphics.
   b. Adhesive masking paper with digitized characters.

2. Apply primer and/or background color as specified on the drawings to surface as
   required. Sign contractor shall assure that paint employed for graphics is compatible with
   surface treatment(s) by others, including but not limited to concrete sealers and/or form
   release agents.

H. PVC- Signs: PVC pipe clearance signs shall have pressure applied decals on black PVC pipe,
   rectangular retroreflective yellow base sticker 3M Diamond Grade yellow sheeting DG³ 4091
   with black border, rounded corners, and black text. See drawings.

   2. 10 in. diameter, Schedule 40 PVC pipe, Corrosion Fluid Products Corporation, Addison,
      IL, or accepted equivalent. Color black.
   3. If black PVC is not available, Paint: "Spraylat" Lacryl B No. 482 High Hiding Black. Meet
      Lacryl system specifications for painting on PVC.
I. **VR- Signs**: Vandal-resistant signs where specified, shall have copy and graphics on second surface.

1. **Base material** shall be one of the following:
   a. "Lexan" General Electric Co., or accepted equivalent. Permanently laminate face panels to backing sheets of material and thickness indicated using manufacturer’s standard process. Except where digital art is required, signs shall be silk screened on second surface or single sheet.
   b. “Modulite/Moducal” by Pannier Graphics or equivalent fiberglass reinforced plastic (FRP) material. Copy and graphics shall be permanently embedded in fiberglass panel. Resulting sign shall be a solid, one-piece panel with graphic elements inseparable from fiberglass in which they are embedded. Laminated or encapsulated products will not be accepted.

2. **Sign shall not** be permanently defaced by steam, acids, aromatics, scratching, inks or paints and should be capable of being readily wiped clean with paint remover without affecting appearance or legibility of graphics. Sign shall retain legibility and finished appearance when sprayed with a 10% solution of hydrochloric, nitric or sulfuric acid for one-half hour or when scrubbed by a brush of medium hardness using common commercial cleaning compounds such as ammonia, laundry soaps, detergents, carbon tetrachloride or petroleum based solvents.

3. **Sign shall be translucent** with a clear or matte finish, as indicated. The index of refraction shall ensure clarity of color, copy and graphics.

4. **Sign shall be router cut** with sign edges not crazed or cracked and edge finish shall be smooth, neat and clean.

5. **Original art and/or multi-colored graphics** shall be digitally produced, electronic media.

6. **Use colored coatings**, including inks and paints for copy and background colors, recommended by manufacturer of sheet for optimum adherence to sheet surface and that are non-fading for application.

7. **Fasteners shall be mechanical**, concealed and tamper proof.

J. **A- Signs**: All signs required to be brailled in compliance with ADA requirements for designating permanent rooms and spaces shall comply with ADA Accessibility Guidelines (ADAAG) as published by the Architectural and Transportation Barriers Compliance Board and ICC/ANSI A117.1, latest editions.

1. **Aluminum**:
   a. Text to be produced with Supersine process die-cut raised letters and brailled copy.

2. **Phenolic-Backed Photopolymer Sheet**, “Jet-388 Phenolic Signage” by JetUSA or equivalent. Provide light sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce composite sheet with overall thickness of 0.15 inches, and substrate thickness of 0.12 inches and a Type D Shore Durometer hardness of 95.

3. **Lettering and Grade II brailled to be raised 1/32".** Lettering to be painted white matte finish. Grade II brailled to be painted out with matte finish background in color shown on drawings. Edges painted same as face.

4. **Produce precisely formed characters** with square cut edges free from burrs and cut marks.

5. **Fasteners shall be mechanical**, concealed and tamper proof.
K. Dimensional Characters (D-Signs):

1. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated. Finish shall be color anodic finish, integrally colored or electrolytically deposited color coating, 0.018 mm or thicker in color specified on schedule, with a satin mechanical finish.
2. Cast Acrylic Sheet: Acrylite FF or equivalent. Cut characters from solid plate.
3. Characters shall have smooth flat faces, sharp corners and precisely formed lines and profiles, free from pits scale, sand holes and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.
4. Illuminated characters: Illuminate characters in manner indicated using manufacturer’s standard lighting components, including light source, transformers, insulators and other components. Make provisions for servicing and concealing connections to building electrical system.
   a. Back-lighted characters: Provide concealed [neon tubes, fiber optics] required by size of characters. Include manufacturer’s hardware for projection mounting of characters at distance from wall surface indicated.
   b. Face-lighted characters: Fabricate character faces from translucent acrylic sheet of thickness indicated. Attach characters to sheet metal back channels. Provide lighting tubes of number and spacing required to illuminate sign faces evenly.

L. Portable Signs (P-):

1. Foldable plastic “A” frame barricade signs.
   a. Provide UV resistant, A-frame, folding sign that accommodates 2 – 24”x36” sign/graphic inserts.
   b. Provide message sign/graphic insert of ¼” Sintra, Aluminum or DiBond base with pressure applied or silk screened background and pressure applied message. Insert message is replaceable. If providing a regulatory or warning message, use retroreflective background and message to meet MUTCD requirements.
   c. Sign shall be able to be weighted by the addition of sand or water.
   d. Sign shall be stackable and portable.
   e. Manufacturer/Supplier: Plasticade Products or equal.

2. Portable Curb Signs, also called Spring Curb Signs.
   a. Self standing, heavy duty aluminum spring supported sign.
   b. Dual spring steel base.
   c. Powder coated or painted finish as acceptable to Owner.
   d. Provide all weather aluminum back panel.
   e. Accommodates 2 message plaques for double sided message.
   f. Aluminum or DiBond plaques sized to match frame with pressure applied or silk screen background and graphics.

3. Rollaway Portable Signs.
   a. Provide self-standing, aluminum framed, dual sided sign with roller supports.
   b. Product: WindMaster ® Curb Signs or Equal.
   c. Manufacturer/Supplier: Marketing Displays International.
M. Dynamic Message Signs (DM- Signs):


2. System to be Daktronics Vanguard VMS or equivalent. Each message line shall be variable and programmable. Display technology shall be LED using aluminum gallium indium phosphide (AlGaNp) diodes. Each digit shall be 7” high, with 7 LED bar segments in amber unless noted otherwise on drawings. The number of characters and/or lines per sign is variable by location, as shown on the drawings.

3. Product shall include all hardware and hardware for Central Control of messages including a computer terminal dedicated thereto. System shall be National Transportation Communications for ITS Protocol (NTCIP) compliant. Control software shall use Windows® NT operating system, with the following features:
   a. User interface configurable for specific sign size (WYSIWYG).
   b. Multiple security password levels.
   c. Message creation & editing capability.
   d. Graphics display capability.
   e. Fonts can be changed and customized to fit client needs.
   f. Message preview function.
   g. Flexible message library.
   h. Message scheduling.
   i. Scenario manager.
   j. Quick message capability.
   k. Real-time message verification.
   l. Automatic or manual dimming.
   m. Sign status monitoring.
   n. VMS system diagnostics (pixels, power supplies, etc.).
   o. Controls multiple signs within VMS network.
   p. Interfaces with various communication systems (telephone, cellular, fiber, radio, CDPD).
   q. Map view user interface.

4. Functional Requirements:
   a. The number of messages per sign required is variable by location, as shown on the drawings.
   b. All messages shall be clearly legible, attracting attention under any lighting condition. At full intensity, sign shall be visible anywhere within 60º cone centered about optic axis.
   c. Where two-way messages are specified, each shall be single or mult-message overlay.
   d. Sign shall completely blank out when not energized. No phantom message shall be visible under any ambient light condition.
   e. Technology shall be solid state, redundant circuitry so that removal or failure of one component has minimal or no effect on overall sign performance.
   f. Signs shall be capable of continuous operation from -35º F to 165º F.

N. Exterior non-illuminated panel signs (EP- Signs):
1. Sign design, construction fabrication and assembly shall be contractor responsibility. Where free-standing, supports shall meet AASHTO Standard Specifications for Highway Signs, Luminaries and Traffic Signals (Latest edition.) FRP, DiBond or aluminum panels are acceptable. Wood is not acceptable.

2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:
   a. Pressure applied [reflective, non-reflective] letters/symbols.
   b. Silk screened.
   c. Digitally produced graphic media.

3. No buckling, weaving, or oil canning of face panels will be accepted.

4. Sign mounting to be as noted as drawings from among following:
   a. Wall or ceiling mount: Provide mounting channel brackets as required by sign size and location.
   b. Post mount: Sign to be mounted on aluminum posts at both ends, with base plate bolted to concrete foundation to below local frost depth or a minimum of 2'6", which ever is greater. Coordinate anchor bolt locations with general contractor.
   c. Flag mount: Sign to be mounted on single aluminum post, with base plate bolted to concrete foundation to below local frost depth or a minimum of 2'6", which ever is greater. Coordinate anchor bolt locations with general contractor.
   d. Concrete pedestal mount: Sign to be mounted on concrete pedestal of dimensions detailed on drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
   e. Aluminum pedestal mount: Provide aluminum pedestal cover per drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
   f. Overhead mount: Where overhead signs are to be mounted over roadways, support frame shall be designed in accordance with state department of transportation requirements for overhead signs.

5. All fasteners and brackets to be non-corrosive.

6. Externally illuminated panels: Where specified, illuminate panels in manner indicated using manufacturer’s standard lighting components, including light source, transformers, insulators and other components. Make provisions for servicing and concealing connections to building electrical system. Provide lighting tubes of number and spacing required to illuminate sign faces evenly.

O. Fasteners and Supports:

2. Rivets for signs: ASTM B 316, Alloy 6063-T61 or equivalent. Aluminum alloy blind rivets of self-plugging variety may be substituted for solid aluminum alloy rivets, subject to acceptance by Engineer/Architect.
3. Use concealed fasteners fabricated from metals not corrosive to sign material and mounting surface.
4. Anchors and Inserts: Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
5. Sign posts: ASTM A 499 Grade 60 or ASTM A 576, Grade 1080 and meeting mechanical properties specified in ASTM A 499 for Grade 60 steel.
6. Posts shall be zinc coated per ASTM A 123. Posts shall be straight, with smooth, uniform finish, free from defects affecting strength, durability, or appearance. Punch bolt holes such that post face shall be smooth and even. All holes and ends shall be burr free. After all fabrication, flow coat posts with durable, exterior type, rust inhibiting paint. Paint color: black, unless otherwise indicated on Drawings.

7. Adhesives, where used for wall mounted signs, shall be per the sign material manufacturer’s recommendations.

8. For DiBond signs, fasteners and mountings shall follow manufacturer’s recommendations. Minimum edge distance of 0.75” or 2.5 times the diameter of the fastener being used is recommended as the distance from the center of the hole to the edge of the panel. Large flat washers shall be used to prevent crushing of the sign material.

P. Cantilever Sign Supports:

1. Pipe for poles and arms: steel pipe, ASTM A53, Grade B, Type E or S.
3. Castings: Free of sharp edges and irregularities. Pole top and end cap castings: ASTM A 126, Class A.
4. Bolts: Connect arm connection flanges with galvanized high strength steel bolts, nuts, and washers per ASTM A 325. Hot dip galvanize fasteners per ASTM A 153. Galvanized nuts shall be tapped oversized per ASTM A 563, and Supplementary requirement S1, "Lubricant and Test for Coated Nuts."
5. Welding: Applicable requirements of Sections of Division 05.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

A. Prepare and clean in strict accordance with paint manufacturer's instructions and as specified here, for each substrate condition.

B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.

C. Cementitious Surfaces:

1. Prepare surfaces to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and, by roughening as required, glaze.
2. Determine alkalinity and moisture content of surfaces to be painted by appropriate testing. If surfaces found to be sufficiently alkaline to cause blistering and burring of finish paint, correct before painting. Do not paint on surfaces with moisture content exceeds manufacturer's limits.

D. Ferrous Metals: Clean uncoated ferrous surfaces of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. Clean previously coated metals in accordance with manufacturer recommendation.
3.2 MATERIALS PREPARATION FOR PAINTED SIGNS

A. Mix and prepare painting materials per manufacturer's directions.

B. Store materials not in use in tightly covered containers. Keep all containers clean, free of foreign materials and residue.

C. Stir materials before applying to produce uniform mixture, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using if necessary.

3.3 INSTALLATION

A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.

B. For drilled anchors in concrete, verify location of embedded reinforcing steel, post-tensioning, or pre-stressing cables prior to installation.

C. Wall Mounted Panel Signs: Attach to wall surfaces with Hilti "Hit" anchors or ITW Ramset/Red Head Hammer Set anchors into concrete or masonry surfaces as shown on Drawings. DO NOT OVERDRIVE anchors, as overdriven anchors will damage sign faces and spall concrete.

D. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs which project at right angles from walls or ceilings. Attach brackets securely to walls or ceilings with concealed fasteners and anchors per manufacturer's directions.

E. Installation of signs shall conform to requirements of Americans with Disabilities Act (ADA) and/or state or local accessibility standards.

3.4 CLEANING AND PROTECTION

A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.

B. Cleanup: During progress of Work, remove from site all discarded materials and rubbish at end of each day.

C. Upon completion of painting, clean all paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

D. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing. Correct any damage by cleaning, repairing, or replacing, and repainting, as acceptable to Engineer/Architect.

E. Provide "Wet Paint" signs as required.
END OF SECTION 10 14 00

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SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS
A. Maintenance data.

1.4 COORDINATION
A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET - FEC
A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Specialties, Inc.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Larsens Manufacturing Company.
   d. Potter Roemer LLC.

B. Cabinet Construction: Nonrated.
C. Cabinet Material: Stainless-steel sheet.

D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless steel sheet.

G. Door Style: Center glass panel with frame.

H. Door Glazing: Tempered break glass.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:
   1. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
   2. Door Lock: Cylinder lock, keyed alike to other cabinets.
   3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet door.
         3) Lettering Color: Red.
         4) Orientation: Vertical.

K. Materials:
   1. Stainless Steel: ASTM A 666, Type 304.
      a. Finish: No. 4 directional satin finish.
   2. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
C. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413
SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS
A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.

1.5 COORDINATION
A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
   a. Ansul Incorporated; Tyco International.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Larsens Manufacturing Company.
   d. Potter Roemer LLC.

2. **Instruction Labels:** Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. **Multipurpose Dry-Chemical Type FE:** UL-rated 10# nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416
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### Architects: A&E / ZGF

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<th>Name</th>
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SECTION 21 00 00 - FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install an automatic sprinkler system and Class 1 manual dry standpipe system to protect the entire new parking garage as indicated herein and as shown on the Drawings.

B. All portions of the systems shall be installed in accordance with the drawings, details, and specifications and as required by jurisdictional authorities and codes. Jurisdictional authorities and codes shall take precedence over plans, details and specifications in the event of a dispute between the requirements of contract documents and jurisdictional authorities or codes.

C. The position is taken that the Owner is entitled to a project which meets or exceeds the minimum requirements of nationally recognized fire protection standards. All efforts and installations shall be directed toward this end. All deficiencies as noted by fire rating bureaus, insurance service offices or jurisdictional authorities shall be corrected. No extra charges will be allowed on this account.

D. The intent of these specifications is to describe the complete systems to be installed, including minor details of work or materials not specifically mentioned or shown, but necessary for the successful operation and completion of the installation.

E. Work to be performed under this section shall include, but not be limited to the following:

1. Excavation, backfill and compaction for the fire system supply.
2. Automatic fire sprinkler systems.

a. Class 1 manual standpipe system.

1) Pipe and fittings.
2) Hangers and supports.
3) Earthquake bracing.
4) Valves.
5) Specialties.

F. The following areas shall be furnished with an automatic fire protection system of type or types as required:

1. The open Parking Garage - Class 1 manual standpipe system or other NFPA compliant system.

1.2 RELATED WORK

A. All work performed under this section of the specifications shall be subject to the requirements of both the General and Special Conditions and the Mechanical Specification.
1.3 REGULATORY AGENCIES

A. The term jurisdictional authority used in this section of the specification shall include, as applicable, but not be limited to the following:

1. City of Bozeman Fire Department.

B. The design and installation of all systems of fire protection shall conform to all requirements of applicable codes and publications herein defined:

1. International Building Code
2. International Fire Code
3. NFPA 13
4. NFPA 14
5. NFPA 10
6. NFPA 17
7. All State and local ordinances
8. Underwriters' Laboratories
9. Industrial Risk Insurers/Factory Mutual
10. American Society of Testing Materials
11. American National Standards Institute

1.4 SUBMITTALS

A. The successful Contractor shall provide submittal data as required under other portions of this specification. Submittals shall conform to the instructions set forth in the General and Special Conditions of these specifications entitled Shop Drawings and Submittals.

B. Submit shop drawings (floor plans - detailed working drawings), showing dimensions, ducts, lights, or other items affecting the fire protection systems to jurisdictional agencies for review and approval, including all Authorities Having Jurisdiction (including, but not limited to the local Fire Marshall.) All items identified in NFPA 13 and NFPA 14 for proper working drawings shall be complied with. The Architect will reject all submittals not in compliance. Submit all necessary shop drawings to authorities having jurisdiction. Concurrently, electronic submittals shall be sent to the Architect for review. After approval from jurisdictional agencies have been returned to the Contractor, they shall be submitted to the Architect for final acceptance. These final acceptance sets shall have all agencies' stamps of review and acceptance. Where there is conflict between the Contract Drawings and/or Specifications, and the recommendations of the jurisdictional authorities, the conflict shall be brought to the attention of the Architect at least ten (10) days prior to bidding or be resolved at no cost to the Owner.

C. Architect's review will be for general location only. It will be the Contractor's responsibility to check his drawings for interference and to do shop fabrication from measurements taken at the job site.

D. Work on the project shall not begin until plans have been reviewed by the Architect.

E. Eight (8) sets of full catalog information shall be submitted for approval for all materials provided.

F. Adequately bind each submittal package. Unbound submittals will be returned without review.
G. The preparation of all shop drawings and hydraulic calculations shall be accomplished by a Registered Engineer, licensed in the State of Montana, if required by local authorities. At a minimum, work must be done by a NICET Level 3 technician.

1.5 JOB CONDITIONS

A. The Contractor shall investigate the structural, mechanical, electrical, and finished conditions affecting the piping, and shall arrange the equipment accordingly; furnishing required fittings, offsets and accessories. Route fire protection piping to avoid interference with ductwork and drain piping. In the event it becomes necessary to make field changes in pipe locations due to building construction, the Contractor shall consult with the Architect before making any changes. Any such changes required shall be made without added cost to the Owner.

B. The Contractor shall determine, and be responsible for, the proper locations and type of inserts for hangers, chases, sleeves, and other openings in the construction required for fire protection work, and shall obtain this information well in advance of the construction progress to avoid delay of the work.

C. The drawings indicate approximate locations of sprinkler equipment. Contractor is responsible for final locations and routing.

D. All fees and permits specifically required for fire protection work, not obtained by others as specified elsewhere shall be applied for and paid for by this Contractor.

E. All systems of fire protection shall be installed by a licensed (for the location of installation) Fire Protection Contractor, fully experienced in fire protection installation as specified herein.

F. Fire Protection Contractors may be required to provide in writing, specific information as to successfully completed projects and references to show cause as to why they should be considered acceptable to the Architect.

1.6 RECORD DRAWINGS

A. One approved set of drawings shall be maintained on the job at all times.

B. One reproducible set of As-Built drawings shall be provided to the Architect upon completion of the work.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Three (3) sets of operating and maintenance instructions shall be provided the Owner upon completion. Manuals shall include, as a minimum, the following:

1. As-Built Drawings
2. NFPA 25
3. Catalog cut sheets of all materials installed
4. Equipment maintenance manuals
1.8 TRAINING

A. The Fire Protection Contractor shall instruct the Owner in the operation of the systems. Instruction shall continue until the Owner is fully satisfied that he understands the operation of his system.

1.9 GUARANTEES AND WARRANTIES

A. The Fire Protection Contractor shall guarantee to the Owner in writing, all equipment and workmanship for a period of one (1) year after the fire protection system has been placed in continuous service and has been accepted by all authorities having jurisdiction.

B. The Fire Protection Contractor shall not be held responsible for improper or negligent maintenance by the Owner after operating and maintenance indoctrination has been given the Owner.

END OF SECTION 21 00 00
SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Fire-suppression demolition.
7. Concrete bases.
8. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
C. Pressure Plates: Stainless steel. Include two for each sealing element.
D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
2.4 SLEEVES

A. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.


2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

3.3 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section ".

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.5 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor fire-suppression materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.6 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 21 05 00
SECTION 21 12 00 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Fire-department connections.
5. Alarm devices.
6. Pressure gages.

1.2 SYSTEM DESCRIPTIONS

A. Manual Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Qualification Data: For qualified Installer.
E. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Welding certificates.


H. Field quality-control reports.

I. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight (Schedule 40), Galvanized-Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135; ASTM A 795/A795M; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

D. Galvanized, Steel Couplings: ASTM A 865, threaded.

E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

F. Malleable- or Ductile-Iron Unions: UL 860.


H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.


J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Corcoran Piping System Co.
   c. National Fittings, Inc.
   d. Shurjoint Piping Products.
   e. Tyco Fire & Building Products LP.
   f. Victaulic Company.

2. Pressure Rating: 175 psig minimum.


4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

   1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

   1. Valves shall be UL listed or FM approved.
B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves.
   f. Crane Co.; Crane Valve Group; Jenkins Valves.
   g. Crane Co.; Crane Valve Group; Stockham Division.
   h. Fire-End & Croker Corporation.
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation.
   l. Groeniger & Company.
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca.
   o. Metraflex, Inc.
   p. Milwaukee Valve Company.
   q. Mueller Co.; Water Products Division.
   r. NIBCO INC.
   s. Potter Roemer.
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products.
   v. Tyco Fire & Building Products LP.
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.
   y. Victaulic Company.
   z. Viking Corporation.
   aa. Watts Water Technologies, Inc.

4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.

5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufactures: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Shurjoint Piping Products.
   l. Tyco Fire & Building Products LP.
   m. United Brass Works, Inc.
   n. Watts Water Technologies, Inc.

4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufactures: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Shurjoint Piping Products.
   h. Tyco Fire & Building Products LP.
   i. Victaulic Company.

2. Standard: UL 1091.
4. Valves NPS 2 and Smaller:

   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.

5. Valves NPS 2-1/2 and Larger:
2.5 HOSE CONNECTIONS

A. Adjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Potter Roemer.
   h. Tyco Fire & Building Products LP.
   i. Wilson & Cousins Inc.
   j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.

2. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.

3. Pressure Rating: 300 psig minimum.

4. Material: Brass or bronze.

5. Size: NPS 2-1/2, as indicated.

6. Inlet: Female pipe threads.

7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.

8. Pattern: Angle or gate.

9. Pressure-Control Device Type: Pressure reducing.

10. Finish: Rough brass or bronze.

B. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   c. Fire-End & Croker Corporation.
   d. Fire Protection Products, Inc.
   e. GMR International Equipment Corporation.
   f. Guardian Fire Equipment, Inc.
   g. Kennedy Valve; a division of McWane, Inc.
   h. Mueller Co.; Water Products Division.
   i. NIBCO INC.
2.6 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.

3. Type: Flush, for wall mounting.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
10. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

2.8 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Cast-Brass Escutcheons: rough-brass finish with set-screws.

D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.

E. Split-Casting, Cast-Brass Escutcheons: Rough-brass finish with concealed hinge and set-screw.

F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with exposed-rivet hinge, set-screw or spring clips.

G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 SLEEVES

A. Cast-Iron Wall-Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set-screws.

2.10 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex, Inc.
   4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Stainless steel.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.
2.11 GROUT

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

G. Install alarm devices in piping systems.

H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

J. Drain dry-type standpipe system piping.

K. Pressurize and check dry-type standpipe system piping.
3.2 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system’s pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
3.4 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

D. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10 Section "Fire Extinguisher Cabinets."

3.5 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.6 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:
   1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
   2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
   4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
   5. Bare Piping in Equipment Rooms: One piece, cast brass.
   6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.7 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Permanent sleeves are not required for holes formed by removable PE sleeves.

D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
E. Install sleeves in new partitions, slabs, and walls as they are built.

F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

H. Seal space outside of sleeves in concrete slabs and walls with grout.

I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
   a. Extend sleeves 2 inches above finished floor level.
   b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."

3. Sleeves for Piping Passing through Gypsum-Board Partitions:
   a. PVC-pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
   c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Galvanized-steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
   b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
   c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:
   a. PVC-pipe sleeves for pipes smaller than NPS 6.
   b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.

K. Fire-Banner Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."
3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 PIPING SCHEDULE

A. Dry-type, fire-suppression standpipe piping, shall be one of the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 21 12 00
PART 1 - GENERAL

1.1 MECHANICAL REQUIREMENTS

A. The mechanical requirements are supplemental to the General Requirements of these Specifications. The Mechanical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Mechanical Systems for this project.

B. The work shall include all items, articles, materials, operations and methods listed, mentioned, or scheduled in these specifications and the accompanying drawings. All material, equipment, and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.

C. Examine and refer to all Architectural, Civil, Structural, Electrical, Utility, and Landscape drawings and specifications for construction conditions which may affect the mechanical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

D. See general requirements for listed Alternate Bids. Note alternates listed and include any changes in work and price required to meet the requirements of the respective alternate.

1.2 CODES AND STANDARDS

A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:

1. American Society of Mechanical Engineers (ASME)
2. American Water Works Association (AWWA)
3. National Electrical Code (NEC)
4. National Electrical Manufacturers Association (NEMA)
5. National Fire Protection Association (NFPA)
6. Uniform Plumbing Code
7. Occupational Safety & Health Act (OSHA)
8. Plastic Pipe Institute (PPI)
9. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
10. International Mechanical Code (IMC)
12. Requirements of the Serving Utility Company
13. Local and State Codes and Ordinances
14. SMACNA Seismic Manual
1.3 FEES AND PERMITS

A. The Mechanical Contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.

1.4 MATERIALS AND EQUIPMENT

A. Manufacturers trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed must have prior approval. Written prior approval must be obtained from the Architect/Engineer ten (10) days prior to bid opening. Requests are to be submitted sufficiently ahead of the deadline to give ample time for examination. The items approved will be listed in an addendum and only this list of equipment will be accepted in lieu of specified products. Submittals must indicate the specific item or items to be furnished in lieu of those specified, together with complete technical and comparative data on specified items and proposed items. See list of prior approved manufacturers at end of this section.

B. Mechanical equipment may be installed with manufacturer’s standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.

C. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.

D. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.

E. This Contractor shall make the required arrangement with General Contractor for the introduction into the building of equipment too large to pass through finished openings.

F. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

1.5 INTENT OF DRAWINGS

A. The drawings are partly diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.6 RESPONSIBILITY

A. The Mechanical Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost,
all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.

B. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the Architectural, Civil, Structural, Landscape and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.

C. Location of mechanical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at the Contractor’s expense.

D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed.

E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.

F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor’s risk.

G. At all times during the performance of this Contract, properly protect work from damage and protect the Owner’s property from injury of loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.

H. The Contractor shall be responsible for damages due to the work of their Contractors, to the building or its contents, people, etc.

1.7 REVIEW

A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform with these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor’s expense.

1.8 WORKMANSHIP

A. GENERAL

1. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. EXCAVATION AND BACKFILL
1. Provide all excavating and backfilling as required, with backfilling only after approval of the Architect. Backfill to be free of all debris and decayable matter. See Excavation and Backfill requirements in SECTION 31 20 00 – EARTH MOVING.

C. CUTTING, PATCHING, AND FRAMING

1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.

2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this Contractor for his work. Whether chases, etc., are provided by this Contractor or others, this Contractor is responsible for correct size and locations.

1.9 COORDINATION

A. This Contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

1.10 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.

B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all mechanical equipment.

1.11 DUST PROTECTION

A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

1. Contractor may provide a temporary office for himself and for the periodic use by the Architect/Engineer.

B. REMOVAL
PLUMBING GENERAL REQUIREMENTS

1. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS
1. The Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.

D. PROTECTION DEVICES
1. The Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor. The Contractor shall assume all responsibility for which the Owner may be held responsible because of lack of above items.

E. TEMPORARY WATER
1. The Contractor shall provide all water required by his trade for construction. Temporary drinking water shall be provided by Contractor from a proven safe source dispensed by single service containers, until such time as the construction water outlet has been installed, disinfected, and approved for drinking purposes.

F. TEMPORARY FIRE PROTECTION
1. The Contractor shall provide all necessary first-aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The Contractor shall provide general area fire extinguishers only.

1.13 SHOP DRAWINGS
A. Provide bound electronic files of manufacturer's literature and/or certified prints as soon as possible but within thirty (30) days after awarding of Contract, for items of materials, equipment, or systems where called for in specifications. Shop drawings and literature complete showing item used, size, dimensions, capacity, rough-in, etc., as required for complete check and installation. Manufacturers literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.

B. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.
   - Date:
   - Name of Project:
   - Branch of Work:
   - Submitted by:
   - Specification or Plan Reference:

C. Prior to their submission, each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to
the work of other trades, and conformance with sound, safe practices as to erection and
installation. Each submittal shall then bear a stamp evidencing such checking and shall show
corrections made, if any. Submittals requiring extensive corrections shall be revised before
submission. Each submittal not stamped and signed by the Contractor evidencing such checking
will be rejected and returned without review.

D. All submittals will be examined when submitted in proper form for compliance. Such review shall
not relieve the Contractor of responsibility for errors, for deviation from the contract Documents,
nor for violation of sound safety practices.

E. The Contractor shall keep in the field office one print of each submittal which has been reviewed
and stamped by the Architect or Engineer.

F. Submittals will be required for each item of material and equipment furnished as noted in
specifications.

G. Submittals which are incomplete relative to quality requirements, capacity, engineering data,
dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall
include descriptive coding as specified or shown on drawings.

THE ENGINEER WILL PERFORM SHOP DRAWING REVIEW OF EACH ITEM; HOWEVER,
SUBSEQUENT REVIEW OF ITEMS PREVIOUSLY REJECTED WILL BE BILLED TO THE
CONTRACTOR AT A RATE OF $75 PER HOUR.

H. Schedule of Shop Drawings.

1. Piping
2. Valves
3. Insulation
4. Plumbing fixtures
5. Diffusers, grilles, louvers
6. Exhaust fans
7. Air distribution accessories

I. Submittals shall be properly bound in a three-ring binder or equivalent method. Unbound
submittals shall be returned without review.

1.14 OPERATION AND MAINTENANCE MANUALS

A. At the time orders are placed for any item of equipment requiring service or operating
maintenance, the Contractor shall request the manufacturer furnish three (3) copies of
OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall
be included in the brochure of equipment.

1.15 BROCHURE OF EQUIPMENT

A. Upon completion of work, prepare three copies of "Brochure of Equipment" and an electronic
PDF copy containing data pertinent to equipment and systems on job. Binders containing
materials shall be one or more three ring binders of sufficient number to hold all literature.
Contained in binders shall be: Installation, maintenance, and operating instructions for each
piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature
submittal; record drawings, etc.
B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.

C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.16 AS-BUILT DRAWINGS

A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.

B. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.

C. All underground piping and ductwork shall be dimensioned from nearest column and/or exterior walls. The location of all maintenance related items such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on as built drawing.

1.17 PLACING SYSTEMS IN OPERATION

A. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the Contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owner’s operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (1) day.

1.18 WARRANTY

A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.

B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.

C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.

D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.
SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.


G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM for water, sewer or other low temperature (<200°F) applications. NBR for fuels such as fuel oil, propane or natural gas. Silicone for high temperature applications (<400°F) interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Composite. Include two for each sealing element.

D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install piping to allow application of insulation.
K. Select system components with pressure rating equal to or greater than system operating pressure.
L. Install escutcheons for penetrations of walls, ceilings, and floors.
M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.
R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION
A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete or Miscellaneous Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.
3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 22 05 00
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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

D. See Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

E. See Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-acted fastener systems.
B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE
A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS
A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
B. Available Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.
   4. Carpenter & Paterson, Inc.
   5. Empire Industries, Inc.
   6. ERICO/Michigan Hanger Co.
   7. Globe Pipe Hanger Products, Inc.
   8. Grinnell Corp.
   9. GS Metals Corp.
   11. PHD Manufacturing, Inc.
   12. PHS Industries, Inc.
   13. Piping Technology & Products, Inc.
   14. Tolco Inc.
C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:
   2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   3. GS Metals Corp.
   5. Thomas & Betts Corporation.
   6. Tolco Inc.
   7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.
   c. Masterset Fastening Systems, Inc.
   d. MKT Fastening, LLC.
   e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 and larger.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 and larger, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 and larger, requiring clamp flexibility and up to 4 inches of insulation.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 and larger.
6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 and larger, with steel pipe base stanchion support and cast-iron floor flange.
7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 and larger, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 and larger, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS ¾” and larger.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 and larger, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.
SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Equipment labels.
      2. Warning signs and labels.
      3. Pipe labels.

1.2 SUBMITTAL
   A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS
   A. Metal Labels for Equipment:
      1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or
         stamped holes for attachment hardware.
      2. Minimum Label Size: Length and width vary for required label content, but not less than
         2-1/2 by 3/4 inch.
      3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches,
         1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for
         greater viewing distances. Include secondary lettering two-thirds to three-fourths the size
         of principal lettering.
      5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

   B. Plastic Labels for Equipment:
      1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8
         inch thick, and having predrilled holes for attachment hardware.
      4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
      5. Minimum Label Size: Length and width vary for required label content, but not less than
         2-1/2 by 3/4 inch.
      6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches,
         1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for
greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
PART 3 - EXECUTION

3.1 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION
A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION
A. Piping Color-Coding: Painting of piping is specified in Division 09.
B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 30 feet long each run. Reduce intervals to 20 feet in areas of congested piping and equipment.
C. Pipe Label Color Schedule:
   1. Sanitary Waste and Storm Drainage Piping:
      b. Letter Color: Black.

END OF SECTION 22 05 53
SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Mineral fiber.

2. Insulating cements.
3. Adhesives.
5. Sealants.
6. Factory-applied jackets.
8. Field-applied jackets.
10. Securements.
11. Corner angles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   b. Owens Corning; High Temperature Flexible Batt Insulations.

G. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fibrex Insulations Inc.; FBX.
   b. Johns Manville; 1000 Series Spin-Glas.
   c. Owens Corning; High Temperature Industrial Board Insulations.
   d. Rock Wool Manufacturing Company; Delta Board.
   e. Roxul Inc.; Roxul RW.
   f. Thermafiber; Thermafiber Industrial Felt.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Johns Manville; Micro-Lok.
   c. Knauf Insulation; 1000 Pipe Insulation.
2. Type I, 850 deg. F. Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Manson Insulation Inc.; AK Flex.
   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Insulco, Division of MFS, Inc.; SmoothKote.
   c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); 739, Dow Silicone.
   d. Speedline Corporation; Speedline Vinyl Adhesive.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.

2.5 SEALANTS

A. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Service Temperature Range: Minus 100 to plus 300 deg F.
   3. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-76-8.
      b. Foster Products Corporation, H. B. Fuller Company; 95-44.
      c. Marathon Industries, Inc.; 405.
      d. Mon-Eco Industries, Inc.; 44-05.
      e. Vimasco Corporation; 750.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Childers Products, Division of ITW; CP-76.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.


   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.
   c. RPR Products, Inc.; Insul-Mate.

2. Factory cut and rolled to size.

3. Finish and thickness are indicated in field-applied jacket schedules.

4. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

5. Factory-Fabricated Fitting Covers:
   a. Same material, finish, and thickness as jacket.
   b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   c. Tee covers.
   d. Flange and union covers.
   e. End caps.
   f. Beveled collars.
   g. Valve covers.
   h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.

B. Insulation Pins and Hangers:

1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in
position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
   2) GEMCO; Perforated Base.
   3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   1) GEMCO; Nylon Hangers.
   2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
   2) GEMCO; Press and Peel.
   3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.

   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.080-inch nickel-copper alloy or 0.062-inch soft-annealed, galvanized steel.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      b. Childers Products.
      c. PABCO Metals Corporation.
      d. RPR Products, Inc.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.
B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Division 07 Section "Penetration Firestopping" Firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.7 FINISHES

A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location of straight pipe, one locations of threaded fittings, one locations of welded fittings, one locations of threaded strainers, one locations of welded strainers, one locations of threaded valves, and one locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 PIPING INSULATION SCHEDULE

<table>
<thead>
<tr>
<th>System</th>
<th>Pipe Size and Location</th>
<th>Insulation Type and Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storm Drainage Piping, Roof Drain and Sumps Including overflow and standard drains</td>
<td>Above Ground Piping</td>
<td>1-½-inch fiberglass Insulation with ASJ Vapor Barrier Jacket</td>
</tr>
</tbody>
</table>

A. Piping and accessories shall be insulated per the Insulation Application Table.

1. Fiberglass insulation as noted in Insulation Application Table: Mineral-Fiber, Preformed Pipe Insulation, Type I with thickness listed in the table.

B. Storm Piping Where Heat Tracing Is Installed: Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches

3.11 FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Equipment, Concealed:
   1. None.

D. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
   1. None.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. None.

F. Piping, Concealed:
   1. None.

G. Piping, Exposed:
   1. PVC jacket.

END OF SECTION 22 07 00
SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following storm drainage piping inside the building.
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.

1.3 SUBMITTALS
A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS
A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
      a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:

   1. Hubless cast-iron soil pipe and fittings; standard shielded, stainless-steel couplings; and coupled joints.

C. Underground storm drainage piping shall be the following:

   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

E. Install wall-penetration-fitting system at each service pipe penetration through foundation wall. Make installation watertight.

F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

G. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard fittings.
increase and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

H. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

I. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install PVC storm drainage piping according to ASTM D 2665.

L. Install underground PVC storm drainage piping according to ASTM D 2321.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."


C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
   4. NPS 6: 48 inches with 3/4-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

B. Connect storm drainage piping to roof drains and storm drainage specialties.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

   B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

   C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

   D. Test storm drainage piping according to procedures of authorities having jurisdiction.

3.7 CLEANING

   A. Clean interior of piping. Remove dirt and debris as work progresses.

   B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

   C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 22 14 13
SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes the following storm drainage piping specialties:
      1. Cleanouts.
      2. Roof drains.
      3. Miscellaneous storm drainage piping specialties.

1.2 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE
   A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS
   A. Exposed Cast-Iron Cleanouts:
      1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         b. MIFAB, Inc.
         d. Tyler Pipe; Wade Div.
         e. Watts Drainage Products Inc.
         f. Zurn Plumbing Products Group; Specification Drainage Operation.
      2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
      3. Size: Same as connected drainage piping
      4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
      5. Closure: Countersunk, brass plug.
      6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

   B. Cast-Iron Floor Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
b. Oatey.
c. Sioux Chief Manufacturing Company, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.
h. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
7. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Shape: Round.
10. Top Loading Classification: Heavy Duty.
11. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   
b. MIFAB, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Wall Access: Round, nickel-bronze or stainless-steel Insert material wall-installation frame and cover.

2.2 ROOF DRAINS

A. Cast-Iron Roof Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
b. Marathon Roofing Products.
c. MIFAB, Inc.
d. Portals Plus, Inc.
e. Prier Products, Inc.
g. Tyler Pipe; Wade Div.
h. Watts Drainage Products Inc.
i. Zurn Plumbing Products Group; Light Commercial Operation.
j. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
5. Dome Material: Cast iron.
6. Underdeck Clamp: Required.
7. Sump Receiver: Required.

2.3 DECK DRAINS

A. Cast-Iron Parking Deck Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Light Commercial Operation.

2. Pattern: Vandal proof deck drain.
5. Underdeck Clamp: Required.

2.4

2.5 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roof materials are specified in Division 07.

   1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Position roof drains for easy access and maintenance.

F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

G. Install cast-iron soil pipe downspout boots at grade with top of hub 18 inches above grade.

H. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

I. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 14 23
SECTION 23 00 00 - MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 MECHANICAL REQUIREMENTS

A. The mechanical requirements are supplemental to the General Requirements of these Specifications. The Mechanical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Mechanical Systems for this project.

B. The work shall include all items, articles, materials, operations and methods listed, mentioned, or scheduled in these specifications and the accompanying drawings. All material, equipment, and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.

C. Examine and refer to all Architectural, Civil, Structural, Electrical, Utility, Landscape and Mechanical drawings and specifications for construction conditions which may affect the mechanical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

D. See general requirements for listed Alternate Bids. Note alternates listed and include any changes in work and price required to meet the requirements of the respective alternate.

1.2 CODES AND STANDARDS

A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:

1. American Gas Association (AGA)
2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
3. American Society of Mechanical Engineers (ASME)
4. American Water Works Association (AWWA)
5. National Electrical Code (NEC)
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
8. International Plumbing Code
9. Occupational Safety & Health Act (OSHA)
10. Plastic Pipe Institute (PPI)
11. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
12. International Mechanical Code (IMC)
14. Requirements of the Serving Utility Company
15. Local and State Codes and Ordinances
16. SMACNA Seismic Manual
1.3 FEES AND PERMITS

A. The Mechanical Contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.

1.4 MATERIALS AND EQUIPMENT

A. Manufacturers trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed must have prior approval. Written prior approval must be obtained from the Architect/Engineer ten (10) days prior to bid opening. Requests are to be submitted sufficiently ahead of the deadline to give ample time for examination. The items approved will be listed in an addendum and only this list of equipment will be accepted in lieu of specified products. Submittals must indicate the specific item or items to be furnished in lieu of those specified, together with complete technical and comparative data on specified items and proposed items. See list of prior approved manufacturers at end of this section.

B. Mechanical equipment may be installed with manufacturer’s standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.

C. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.

D. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.

E. This Contractor shall make the required arrangement with General Contractor for the introduction into the building of equipment too large to pass through finished openings.

F. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

1.5 INTENT OF DRAWINGS

A. The drawings are partly diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.6 RESPONSIBILITY

A. The Mechanical Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost,
all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.

B. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the Architectural, Civil, Structural, Landscape and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.

C. Location of mechanical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at the Contractor's expense.

D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed.

E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.

F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.

G. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury of loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.

H. The Contractor shall be responsible for damages due to the work of their Contractors, to the building or its contents, people, etc.

1.7 REVIEW

A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform with these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

1.8 WORKMANSHIP

A. GENERAL

1. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. EXCAVATION AND BACKFILL
1. Provide all excavating and backfilling as required, with backfilling only after approval of the Architect. Backfill to be free of all debris and decayable matter. See Excavation and Backfill requirements in DIVISION 31 – EARTH MOVING.

C. CUTTING, PATCHING, AND FRAMING

1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.

2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this Contractor for his work. Whether chases, etc., are provided by this Contractor or others, this Contractor is responsible for correct size and locations.

1.9 COORDINATION

A. This Contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

1.10 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.

B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all mechanical equipment.

1.11 DUST PROTECTION

A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

1. Contractor may provide a temporary office for himself and for the periodic use by the Architect/Engineer including:

   a. Lights, heat, and telephone. (Pay telephone not permitted.)

B. REMOVAL
1. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

1. The Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.

D. PROTECTION DEVICES

1. The Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor. The Contractor shall assume all responsibility for which the Owner may be held responsible because of lack of above items.

E. TEMPORARY WATER

1. The Contractor shall provide all water required by his trade for construction. Temporary drinking water shall be provided by Contractor from a proven safe source dispensed by single service containers, until such time as the construction water outlet has been installed, disinfected, and approved for drinking purposes.

F. TEMPORARY FIRE PROTECTION

1. The Contractor shall provide all necessary first-aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The Contractor shall provide general area fire extinguishers only.

1.13 SHOP DRAWINGS

A. Provide bound electronic copies of manufacturer's literature and/or certified prints as soon as possible but within thirty (30) days after awarding of Contract, for items of materials, equipment, or systems where called for in specifications. Shop drawings and literature complete showing item used, size, dimensions, capacity, rough-in, etc., as required for complete check and installation. Manufacturers literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.

B. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.
   
   Date:
   Name of Project:
   Branch of Work:
   Submitted by:
   Specification or Plan Reference:

C. Prior to their submission, each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to
the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.

D. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the Contractor of responsibility for errors, for deviation from the contract Documents, nor for violation of sound safety practices.

E. The Contractor shall keep in the field office one print of each submittal which has been reviewed and stamped by the Architect or Engineer.

F. Submittals will be required for each item of material and equipment furnished as noted in specifications.

G. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

THE ENGINEER WILL PERFORM SHOP DRAWING REVIEW OF EACH ITEM; HOWEVER, SUBSEQUENT REVIEW OF ITEMS PREVIOUSLY REJECTED WILL BE BILLED TO THE CONTRACTOR AT A RATE OF $75 PER HOUR.

H. Schedule of Shop Drawings.
   1. Piping
   2. Valves
   3. Insulation
   4. Plumbing fixtures
   5. Diffusers, grilles, louvers
   6. Acoustical lining
   7. Exhaust fans
   8. Air distribution accessories

I. Submittals shall be properly bound in a three-ring binder or equivalent method. Unbound submittals shall be returned without review.

1.14 OPERATION AND MAINTENANCE MANUALS

A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the Contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.

1.15 BROCHURE OF EQUIPMENT

A. Upon completion of work, prepare three copies and a PDF copy of “Brochure of Equipment” containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be: Installation, maintenance, and operating instructions for each piece of equipment; parts
lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.

B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.

C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.16 AS-BUILT DRAWINGS

A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.

B. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.

C. All underground piping and ductwork shall be dimensioned from nearest column and/or exterior walls. The location of all maintenance related items such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on as built drawing.

1.17 PLACING SYSTEMS IN OPERATION

A. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the Contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owner’s operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (1) day.

1.18 WARRANTY

A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.

B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.

C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.
D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.

E. Any equipment, including heat exchangers, boilers, pumps, air handlers, motors, etc., used for temporary heat, shall be brought up to a new condition before final acceptance by the Owner and shall be guaranteed by the Contractor as new equipment.

END OF SECTION 23 00 00
SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
B. **Steel Pipe Welding:** Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. **Electrical Characteristics for HVAC Equipment:** Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

**PART 2 - PRODUCTS**

2.1 **PIPE, TUBE, AND FITTINGS**

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. **Pipe Threads:** ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 **JOINING MATERIALS**

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. **Pipe-Flange Gasket Materials:** ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. **Plastic, Pipe-Flange Gasket, Bolts, and Nuts:** Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. **Solder Filler Metals:** ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. **Brazing Filler Metals:** AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. **Welding Filler Metals:** Comply with AWS D10.12.

G. **Solvent Cements for Joining Plastic Piping:**

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 **DIELECTRIC FITTINGS**

A. **Description:** Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. **Insulating Material:** Suitable for system fluid, pressure, and temperature.
C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEAL

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Stainless steel. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

   1. Underdeck Clamp: Clamping ring with set screws.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.
2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.
H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.


F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.


3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.
3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 05 00
SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.


F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 13
SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

C. See Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.

D. See Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.

E. See Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.

F. See Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
1.4  SUBMITTALS

A.  Product Data:  For the following:

   1.  Steel pipe hangers and supports.
   2.  Thermal-hanger shield inserts.
   3.  Powder-actuated fastener systems.

B.  Shop Drawings:  Show fabrication and installation details and include calculations for the following:

   1.  Trapeze pipe hangers.  Include Product Data for components.
   2.  Metal framing systems.  Include Product Data for components.
   3.  Equipment supports.

C.  Welding certificates.

1.5  QUALITY ASSURANCE

A.  Welding:  Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code:  Section IX.

PART 2 - PRODUCTS

2.1  MANUFACTURERS

A.  In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

   1.  Available Manufacturers:  Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2.  Manufacturers:  Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2  STEEL PIPE HANGERS AND SUPPORTS

A.  Description:  MSS SP-58, Types 1 through 58, factory-fabricated components.  Refer to Part 3 “Hanger and Support Applications” Article for where to use specific hanger and support types.

B.  Available Manufacturers:

   1.  AAA Technology & Specialties Co., Inc.
   2.  Bergen-Power Pipe Supports.
   4.  Carpenter & Paterson, Inc.
   5.  Empire Industries, Inc.
   6.  ERICO/Michigan Hanger Co.
   7.  Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.
   c. Masterset Fastening Systems, Inc.
   d. MKT Fastening, LLC.
   e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.
2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
   5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
   6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
   7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
   8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29
SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel [rivets] [rivets or self-tapping screws] [self-tapping screws].

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
PART 3 - EXECUTION

3.1 PREPARATION
A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION
A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION
A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:

1. Storm Sewer Piping:
   a. Background Color: Black.

2. Sewer Piping:
   a. Background Color: Black.

END OF SECTION 23 05 53
SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Balancing Air Systems:
      a. Constant-volume air systems.
   2. Balancing Hydronic Piping Systems:
      a. Constant-flow hydronic systems.

1.2 DEFINITIONS

C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, Adjusting, and Balancing Bureau.
E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Certified TAB reports.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage an Independent TAB entity certified by NEBB. The TAB contractor shall not be engaged in the project in other capacities.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA’s "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.


B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer’s outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

   b. Measure static pressure directly at the fan outlet or through the flexible connection.

   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

3.8 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
a. Indicated versus final performance.
b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
   a. Fan drive settings including settings and percentage of maximum pitch diameter.
   b. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.

3.9 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93
 SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rectangular ducts and fittings.
   2. Round ducts and fittings.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.
   7. Seismic-restraint devices.

B. Related Sections:
   1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
   3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
   4. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Welding certificates.

1.4 QUALITY ASSURANCE


B. Welding Qualifications: Qualify procedures and personnel according to the following:

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Sheet Metal Connectors, Inc.
   e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Maximum Thermal Conductivity:
   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.

7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
1. **Tape**: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. **Tape Width**: 3 inches.
3. **Sealant**: Modified styrene acrylic.
4. **Water resistant**.
5. **Mold and mildew resistant**.
6. **Maximum Static-Pressure Class**: 10-inch wg, positive and negative.
7. **Service**: Indoor and outdoor.
8. **Service Temperature**: Minus 40 to plus 200 deg F.
9. **Substrate**: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. **Water-Based Joint and Seam Sealant**:

1. **Application Method**: Brush on.
2. **Solids Content**: Minimum 65 percent.
4. **Water resistant**.
5. **Mold and mildew resistant**.
6. **VOC**: Maximum 75 g/L (less water).
7. **Maximum Static-Pressure Class**: 10-inch wg, positive and negative.
8. **Service**: Indoor or outdoor.
9. **Substrate**: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. **Flanged Joint Sealant**: Comply with ASTM C 920.

1. **General**: Single-component, acid-curing, silicone, elastomeric.
2. **Type**: S.
3. **Grade**: NS.
4. **Class**: 25.
5. **Use**: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. **Flange Gaskets**: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. **Round Duct Joint O-Ring Seals**:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 **HANGERS AND SUPPORTS**

A. **Hanger Rods for Noncorrosive Environments**: Cadmium-plated steel rods and nuts.

B. **Hanger Rods for Corrosive Environments**: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.
C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 1-inch wg.
   b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.

END OF SECTION 23 31 13
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

2. Flange connectors.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

   1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

      a. Special fittings.
      c. Control damper installations.
      d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
      e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE


B. Comply with AMCA 500-D testing for damper rating.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Air Balance Inc.; a division of Mestek, Inc.
      b. American Warming and Ventilating; a division of Mestek, Inc.
      c. Flexmaster U.S.A., Inc.
      d. McGill AirFlow LLC.
      e. METALAIRE, Inc.
      f. Nailor Industries Inc.
      g. Pottorff; a division of PCI Industries, Inc.
      h. Ruskin Company.
   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.


7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. METALAIRE, Inc.
   f. Nailor Industries Inc.
   g. Pottorff; a division of PCI Industries, Inc.
   h. Ruskin Company.
   i. Trox USA Inc.
   j. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.

4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
   e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.


7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Aluminum.

C. Jackshaft:
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.4 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vaness and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Pottorff; a division of PCI Industries, Inc.
9. Ventfabrics, Inc.


1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.
2.6 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- thick, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.


1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.


1. Minimum Weight: 24 oz./sq. yd..
3. Service Temperature: Minus 50 to plus 250 deg F.
G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.8 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
3. Temperature Range: Minus 10 to plus 160 deg F.

2.9 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. At outdoor-air intakes and mixed-air plenums.
   3. At drain pans and seals.
   4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   5. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   6. At each change in direction and at maximum 50-foot spacing.
   7. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.

I. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment.

K. Connect flexible ducts to metal ducts with draw bands.

L. Install duct test holes where required for testing and balancing purposes.

M. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00
SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Centrifugal roof ventilators.
   2. Ceiling-mounting and in-line ventilators.

1.2 SUBMITTALS
A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Field quality-control test reports.
D. Operation and maintenance data.

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Aerovent; a Twin City Fan Company.
   3. Carnes Company HVAC.
   5. Loren Cook Company.
6. NuTone Inc.
7. Penn Ventilation.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, [spun-aluminum, dome top and outlet baffle] [extruded-aluminum, rectangular top] [galvanized steel, mushroom-domed top]; square, one-piece, aluminum base with venturi inlet cone.
   1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   4. Fan and motor isolated from exhaust airstream.

F. Accessories:
   1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
   2. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
   2. Overall Height: 12 inches.

2.2 CEILING-MOUNTING AND IN-LINE VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ACME
   2. Carnes Company HVAC.
   4. Loren Cook Company.
   5. NuTone Inc.
   6. Penn Ventilation.
B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:
3. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.3 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

G. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

H. Install ducts adjacent to power ventilators to allow service and maintenance.
I. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

J. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 23 34 23
SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Perforated diffusers.
   2. Adjustable bar registers and grilles.
   3. Fixed face registers and grilles.

B. Related Sections:
   1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
   2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 GRILLES REGISTERS AND DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Anemostat Products; a Mestek company.
   2. Carnes.
   3. Hart & Cooley Inc.
   4. METALAIRE, Inc.
   5. Nailor Industries Inc.
   7. Titus.
   8. Tuttle & Bailey.
2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13
SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of roof-mounting intake and relief ventilators:

1. Roof hoods.

B. See Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.

C. See Division 23 Section "HVAC Power Ventilators" for roof-mounting exhaust fans.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
1. Use types and sizes to suit unit installation conditions.
2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 ROOF HOODS

A. Manufacturers:
   2. Aerovent; a Twin City Fan company.
   3. Carnes.
   5. Loren Cook Company.
   6. Penn Ventilation.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood; suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.

   2. Overall Height: 12 inches.

E. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.

C. Install intake and relief ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.

F. Label intake and relief ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

I. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

J. Adjust damper linkages for proper damper operation.

END OF SECTION 23 37 23
SECTION 26 00 00 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 ELECTRICAL REQUIREMENTS

A. The electrical requirements are supplemental to the General and Supplementary Conditions and the General Requirements of these Specifications. The Electrical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Electrical Systems for this project.

B. The work shall include all items, articles, materials, operations and methods listed, mentioned or scheduled in these specifications and the accompanying drawings. All material, equipment and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.

C. Examine and refer to all Architectural, Structural, Civil, Electrical Primary, Landscape and Mechanical drawings and specifications for construction conditions which may affect the electrical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.

D. See general requirements for listed Alternate Bids. Note alternates listed and include any changes in work and price required to meet the requirements of the respective alternate.

1.2 CODES AND STANDARDS

A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following organizations:

1. American National Standards Institute (ANSI)
2. Americans with Disabilities Act (ADA)
3. Certified Ballast Manufacturers (CBM)
4. Electrical Testing Laboratories (ETL)
5. Independent Testing Laboratories (ITL)
7. International Fire Code (IFC)
10. National Electrical Manufacturers Association (NEMA)
11. National Fire Protection Association (NFPA)
12. Occupational Safety & Health Act (OSHA)
13. Underwriters Laboratories (UL)
14. Rules and Regulations of the State Fire Marshal
15. Local and State Codes and Ordinances
1.3  FEES AND PERMITS

A. The electrical contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.

B. Cost of primary work shown in AEI's drawings are by the Electrical Contractor and are to be included in Contractor's Bid.

1.4  MATERIALS AND EQUIPMENT

A. Manufacturer's trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed must have prior approval. Written prior approval must be obtained from the Architect/Engineer ten (10) business days prior to bid opening. Requests are to be submitted sufficiently ahead of the deadline to give ample time for examination. The items approved will be listed in an addendum and only this list of equipment will be accepted in lieu of specified products. Submittals must indicate the specific item or items to be furnished in lieu of those specified, together with complete technical and comparative data on specified items and proposed items.

B. Electrical equipment shall be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.

C. The electrical contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.

D. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer unless herein specified to the contrary.

E. The electrical contractor shall make the required arrangement with General Contractor for the introduction into the building of equipment too large to pass through finished openings.

F. Materials and equipment shall be stored indoors at the job site or, if this is not possible, stored on raised platforms and protected from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

G. Lighting fixtures proposed as substitutes to those specified must have prior approval by Architect/Engineer as noted above. Approval will not be considered unless the request has all of the following information:

1. Manufactures data showing catalog number.
2. Construction details.
3. Photometrics.
4. Recommended maintenance factor.

1.5  INTENT OF DRAWINGS
A. The drawings are partly diagrammatic and do not necessarily show exact location of conduit unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining quantities or lineal runs of conduit. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.6 RESPONSIBILITY

A. The electrical contractor shall be responsible for the installation of satisfactory and complete systems in accordance with the intent of the drawings and specifications and shall provide, at no extra cost, all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.

B. The drawings do not attempt to show complete details of the building construction which affect the electrical installation; and reference is therefore required to the Architectural, Structural, Landscape and Mechanical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.

C. Location of electrical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at no additional expense to the Architect/Engineer or Owner.

D. The electrical contractor shall determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed. Roughing-in fixtures, etc., must be laid out accurately. Connections to equipment of the same class shall be equal heights, plumb, and at right angles to the wall, unless otherwise directed.

E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.

F. The electrical contractor shall take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.

G. At all times during the performance of this contract, the electrical contractor shall properly protect work from damage and protect the Owner's property from injury of loss. The contractor shall make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. The electrical contractor shall adequately protect adjacent property as provided by law and the Bidding Documents. The electrical contractor shall provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.

H. Circuiting and switching shall be exactly as shown on drawings. Combining of home runs is acceptable but neutrals shall not be shared. Contractor shall refer to NEC Article 310-15 and adjust accordingly. Combining of wiring of various systems in conduit runs is not acceptable unless otherwise specified herein or noted on drawings.
I. Neutrals shall not be shared to avoid the requirement of installing handle-ties on breakers.

J. Contractor is responsible for providing UL-listed fire rated materials where required by applicable codes and other sections of this specification to seal fire-rated membrane penetrations. In particular this applies to requirements of IBC Section 712 as it pertains to:

1. **Electrical Boxes:** Provide minimum 6 inch separation in non-rated walls. Provide minimum 24 inch horizontal separation in fire rated walls. In rated walls locate boxes so as to comply with IBC Section 712 separation and membrane penetration requirements. Apply fire-rated putty pads (SpecSeal Series SSP Intumescent Putty Pads, or equal) to all boxes where 24” box-to-box separation cannot be maintained or where openings exceed allowable limits under IBC section 712.

2. **Conduit and Cable:** Apply fire seal where conduit or cables penetrate fire-rated assemblies as required by NEC Article 300-21 and IBC section 712. Fire seal shall be equal to International Protective Coating Corp. #FSC or #FS series or Chase Technology Corp. #PR-855 Fire Stop.

1.7 **INSPECTION**

A. All work and material is subject to inspection at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform with these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at no additional expense to the Owner.

1.8 **WORKMANSHIP**

A. **GENERAL**

1. Work under this contract shall be performed by workmen skilled in the particular trade conducting all work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. **EXCAVATION AND BACKFILL**

1. Provide all excavating and backfilling as required, with backfilling only after approval of the Architect. Backfill to be free of all debris and decayable matter. See Excavation and Backfill requirements in DIVISION 1 -- GENERAL REQUIREMENTS.

C. **CUTTING, PATCHING AND FRAMING**

1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at no additional expense to the Owner.

2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, and framing for equipment are provided by others only if so noted on the drawings. Otherwise, they will be provided by this contractor for his work. Whether chases, etc., are provided by this contractor or others, this contractor is responsible for correct size and locations.
1.9 COORDINATION

A. The electrical contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

1.10 CLEAN UP

A. The electrical contractor shall keep the premises free from accumulation of waste material or rubbish caused by his work or employees.

B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all light fixtures and lamps, remove all labels from fixture lenses.

1.11 DUST PROTECTION

A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

1. The electrical contractor shall provide temporary offices for himself including lights, heat and telephone, if required.

B. REMOVAL

1. The electrical contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

1. The electrical contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the contractor.

D. PROTECTION DEVICES

1. The electrical contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc. required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the contractor. The contractor shall
assume all responsibility for which the owner may be held responsible because of lack of above items.

E. TEMPORARY WATER

1. The electrical contractor shall provide all water required by his trade for construction. Temporary drinking water shall be provided from a proven safe source dispensed by single service containers, until such time as the construction water outlet has been install, disinfected and approved for drinking purposes.

F. TEMPORARY FIRE PROTECTION

1. The electrical contractor shall provide all necessary first-aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The contractor shall provide general area fire extinguishers only.

1.13 TEMPORARY ELECTRICAL FACILITIES

A. ELECTRICAL POWER

1. The electrical contractor shall provide temporary construction power to the remodel area to support construction activities of all trades. All temporary power shall be derived from a separate temporary construction service arranged and paid for by the contractor. No tie-ins or connections to the Owner’s system shall be made without the Owner’s consent. Construction power shall the following unless otherwise agreed to by the General Contractor:

a. One temporary panel located as directed by the General Contractor with provision for 100A, 3-phase, 4-wire service at voltage available.

b. Power centers for miscellaneous tools and equipment used in the construction period, so that power can be secured at any desired point from temporary service panel within building proper.

c. Lighting for safe and adequate working conditions throughout the buildings, stairways, and crawl spaces. Provide at least 1/2 watt of incandescent lighting per square foot of floor area. Maintain a socket voltage of at least 110 volts. Use a minimum of 100 watt bulbs.

d. Power for construction site offices and for other temporary storage and construction buildings.

e. Power to maintain continuous construction during changeover of electrical equipment.

f. Power for testing and checking equipment.

1.14 SHOP DRAWINGS

A. Provide eight (8) copies of manufacturer’s literature and/or certified prints as soon as possible but within thirty (30) days after awarding of Contract, for items of materials, equipment, or systems where called for in specifications. Shop drawings and literature complete showing item used, size, dimensions, capacity, rough-in, etc., as required for complete check and installation. Manufacturer’s literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
B. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.

Date:
Name of Project:
Branch of Work:
Submitted by:
Specification or Plan Reference:

C. Prior to their submission, each submittal shall be thoroughly checked by the contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the contractor evidencing such checking will be rejected and returned without review.

D. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the contractor of responsibility for errors, for deviation from the contract documents, nor for violation of sound safety practices.

E. The contractor shall keep in the field office one print of each submittal which has been reviewed and stamped by the Architect or Engineer.

F. Submittals will be required for each item of material and equipment furnished as noted in specifications.

G. All submittals shall be organized into a single binder and transmitted in one delivery. Transmittal of individual sections is not permitted. Exceptions will be considered upon request for exceptionally long-lead equipment or voluminous submittals that cannot reasonably fit into a single binder.

H. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

THE ENGINEER WILL PERFORM SHOP DRAWING REVIEW OF EACH ITEM, HOWEVER, SUBSEQUENT REVIEW OF ITEMS PREVIOUSLY REJECTED WILL BE BILLED TO THE CONTRACTOR AT A RATE OF $75 PER HOUR.

I. Schedule of Shop Drawings.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>MFG LIT</th>
<th>SHOP DWG</th>
<th>WIRING DIAG.</th>
<th>O&amp;M BOOK</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACEWAYS AND FITTINGS</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WIRE AND CABLE</td>
<td>X</td>
<td></td>
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<tr>
<td>OUTLET BOXES</td>
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<tr>
<td>WIRING DEVICES</td>
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</tr>
<tr>
<td>FIRE SEAL PRODUCTS</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
1.15 OPERATION AND MAINTENANCE MANUALS

A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.

1.16 BROCHURE OF EQUIPMENT

A. Upon completion of work, prepare a "Brochure of Equipment" containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be: Installation, maintenance, and operating instructions for each piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.

B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.

C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.17 "AS- BUILT" DRAWINGS

A. The electrical contractor shall furnish to the Owner and Architect/Engineer a red line marked print set of drawings, each sheet stamped as the "As-Built" drawing and bearing the contractor's name, date and signature. The As-Built drawing shall show the location of all concealed or underground conduit runs and other equipment, devices, outlets, etc., installed other than as shown on the drawings. Dimension underground lines from established building lines. As-Built drawings to be developed from a job site record drawing set and shall be clean, neat and all changes legible and shown in the same format and symbols used on the contract drawings. The As-Built drawing set shall be submitted to the architect/engineer for approval, and any deficiencies noted by the architect/engineer corrected and resubmitted until approved by the architect/engineer at no cost to architect/engineer or owner.
1.18 PLACING SYSTEMS IN OPERATION

A. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the electrical contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owners operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (1) day.

B. Upon placing systems in operation the contractor shall measure phase currents at each main and branch panel within the facility, including existing panels, and balance the phase currents to within 20% of each other by moving circuit breakers to different phases.

1.19 GUARANTEE-WARRANTY

A. The electrical contractor shall and hereby does warrant and guarantee that all work executed under this Division will be free from defects of materials and workmanship for a period of one year from the date of final acceptance of this work and that he will, at his own expense, repair and/or replace all such defective materials and work and all other work damaged thereby which becomes defective during the term of warranty, except that lamps and tubes shall be his responsibility only for normal lamp life or one year, whichever occurs first.

END OF SECTION 26 00 00
SECTION 26 05 13.16 - MEDIUM-VOLTAGE, SINGLE- AND MULTI-CONDUCTOR CABLES

PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0543 – Underground Ducts and Raceways for Electrical Systems
   B. Section 26 0812 – Power Distribution Acceptance Tests
   C. Section 26 0813 – Power Distribution Acceptance Test Tables

1.2 DESCRIPTION
   A. Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.
   B. Cables are for use in underground duct applications.
   C. Conductors shall be rated to operate at conductor temperature of 90°C for continuous normal operation, 130°C for emergency overload conditions, and 250°C for short circuit conditions, based on 40°C maximum ambient temperature.
   D. Conductor sizes in Section are based on copper wire and only copper wire shall be used.

1.3 REFERENCE STANDARDS
   A. AEIC CS6 – Specification for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69kV
   B. ASTM B-8 – Standard Specification for Concentric-Lay Stranded Copper Conductors, Hard, Medium-Hard or Soft
   C. ICEA S-94-649 – 5-46kV Concentric Neutral Cables Rated 5000 to 46000 Volts
   D. IEEE 48 – Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5kV through 765kV
   E. IEEE 386 – Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V (ANSI)
   F. IEEE 404 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 – 500000 V (ANSI)
   G. IEEE 576 – Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications (ANSI)
   H. NFPA 70 – National Electrical Code
I. UL 1072 – Medium-Voltage Power Cable

1.4 SUBMITTALS

A. Product Data: For each type of cable indicated. Include splices and terminations for cable and cable accessories.
   1. Include cable drawings with the following data:
      a. Longitudinal cutback and cross-sectional view of cable.
      b. Identification and structure of cable components.
      c. Dimensions of cable components in English and SI units.

B. Material Certificates: For each cable and accessory type, signed by manufacturer.

C. Manufacturer Testing Certificate: For each type and voltage class of cable indicated.

D. Certified Field Quality Control Test Reports per requirements in Section 26 0812 – Power Distribution Acceptance Tests and Section 26 0813 – Power Distribution Acceptance Test Tables for each type and voltage class of cable indicated. Indicate applicable standards compliance. Interpret test results and corrective action taken for compliance with specification requirements.

E. Qualification Data: For testing agency.

F. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.

G. Installation Guide: Include the following:
   1. Maximum allowable pulling tension (in pounds and newtons)
   2. Minimum allowable bending radius
   3. Recommended pulling compounds
   4. Splicing and termination instructions with diagrams, dimensions, and material lists
   5. Weight per 1,000 ft
   6. Standard “packaging” of reels (i.e., lengths, lagging, banding, etc.)
   7. Reactance and AC resistance (ohms to neutral) of each size and voltage class of cable, both in magnetic and non-magnetic duct, based on 3-1/C cables or 1-3/C cable in one duct.

H. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of cables, splices, and terminations.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.5 QUALITY ASSURANCE

A. Installer: Engage cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable, having not less than 3 yrs experience as licensed electrician.
B. Regulatory Requirements:
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

C. Source Limitations: Obtain cables and accessories through one source from single manufacturer.

D. All cables shall be of a single type and configuration. Date of manufacture shall not precede contract date by more than one year.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Coordinate with manufacturer to provide protective covering over cable and reel to prevent damage during shipping, storage, or handling.
B. Store in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.7 WARRANTY
A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.
B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Cables:
   1. General Cable (Cablec)
   2. Kerite
   3. Okonite
   4. Prysmian (Pirelli)
B. Cable Splicing and Terminating Products and Accessories:
   1. Raychem Corporation
   2. RTE Components; Cooper Power Systems, Inc.
   3. Thomas & Betts Corporation/Elastimold
   4. 3M; Electrical Products Division

2.2 CABLES
A. Cable Type: MV90
B. Comply with UL 1072, AEIC CS6, ICEA S-93-639, and ICEA S-94-649

C. Conductor: Copper

D. Conductor Insulation: Ethylene-propylene-rubber

E. Voltage Rating: 15 kV

F. Insulation Thickness: 133 percent (220 mil) insulation level

G. Concentric Neutral: Solid copper wires shall be spirally applied to provide neutral rating equal to 1/3 of the cable conductor current rating.

H. Cable Jacket: 80 mil extruded, chlorinated, polyethylene jacket. Color: black, unless otherwise designated

I. Cables utilizing combination insulation shield and jacket are acceptable.

J. Cable lengths shall be supplied with factory-installed, moisture-proof end seals on conductors on each end. Cable seals shall be rubber or plastic caps, and shall prevent moisture from seeping into cable ends.

K. Each cable reel shall be tagged with the following:
   1. Manufacturer
   2. Cable Size
   3. Cable Type
   4. Voltage Class
   5. Manufacture Date
   6. Cable Length
   7. Tolerances
   8. Reel Number
   10. Customer Name

L. Surface Marking:
   1. Cables shall be permanently printed (or imprinted) on jacket surface at regular intervals over entire length of cable with the following:
      a. Manufacturer’s name
      b. Cable type
      c. Insulation type and thickness
      d. Conductor size and type
      e. Voltage class
      f. Sequential footage number
      g. Year of manufacture
      h. UL designation

M. Cables shall be constructed and rated for continuous and intermittent submersion in water and shall be suitable for installation in conduit and underground duct.

N. Cable shield shall be capable of withstanding fault current indicated on drawings for 1/10 second.
2.3 SPLICE KITS

A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include components required for complete splice, with detailed instructions.
   1. Combination tape and cold-shrink-rubber sleeve kit with rejetacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.

2.4 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Load-Break Cable Terminators: Elbow-type units with 200A and 600A, 15 kV class, 95 KV BIL load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated, with steel-reinforced hook-stick eye, grounding eye, and arc-quenching material. Include capacitance coupled test point on terminator body. Include cold shrinkable metallic shield adapter kit to ground metallic shielded cable. Include connection bus with parking stand for wall mounting.

C. Test-Pont Fault Indicators: Sealed and self-contained applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

D. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.5 ARC-PROOFING MATERIALS

A. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3” thick, compatible with cable jacket.

2.6 FAULT INDICATORS

A. Indicators: Automatic current reset fault indicator, arranged to clamp to cable sheath and provide a display after fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.

2.7 CONDUCTOR IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend.

B. Manufacturers: Brady USA, Ideal, Marking Services, Inc. (MRI), Seton, or approved equal.

C. Color-Coding Conductor Tape: Orange, self-adhesive vinyl tape not less than 3 mils thick by 1” to 2” wide.
D. Metal Tags: Brass or aluminum, 2" x 2" x 0.05", with stamped legend, punched for use with self-locking nylon tie fastener.

E. Identification shall include:
   1. Circuit (CKT11A")
   2. Phase ("PhA, PhB, PhC")
   3. Destination Station Number ("ToSTA11A-1")

F. Tags shall not start with the word "FROM".

2.8 SOURCE QUALITY CONTROL

A. Test and inspect cables according to Section 26 0812 – Power Distribution Acceptance Tests and Section 26 0813 – Power Distribution Acceptance Test Tables.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Pull Conductors: Do not exceed manufacturer's recommended minimum installation temperature, maximum pulling tensions, and sidewall pressure values.
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
   2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
   3. Cut off cable damaged by cable grips or pulling make-ups so as to provide clean, undamaged cable for termination. Continuously record pulling tension during installation.
   4. Make attachment to cable by compression or epoxy filled pulling eye and provide break away (clutch) tension device.

C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

D. Support cables in handholes and manholes from walls on heavy-duty, non-metallic cable rack arms, at least 3" above the floor. Support cables with reinforced nylon cradles. Anchor to wall with stainless steel anchor bolts. Refer to drawings for details.

E. In manholes and cable vaults, train cables around walls by longest route from entry to exit and support cables at intervals adequate to prevent sag. Fill lowest ducts first, avoid covering or blocking duct entrances and allow space for future cable installation.

F. Provide loop around each manhole as designated on plans.

G. Cut cable in clean, dry environment. Seal cut ends with waterproof seal immediately after cutting. Maintain a seal during and after pulling.

H. Install cable splices at pull points (accessible locations) and elsewhere as indicated.
I. Install terminations at ends of conductors. Do not install exterior terminations during inclement weather or damp atmospheric conditions.

J. Install stress cones at cable splices and terminations, grounded per cable and connector manufacturer recommendations.

K. Check phase rotation before connections are made to existing circuits. Clearly letter cable terminations. Identify phases with phase designations lettered on terminal boxes and other terminations throughout the system.

L. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape and/or manufacturer’s written instructions, apply arc proofing as follows:
   1. Clean cable sheath.
   2. Wrap metallic cable components with 10 mil pipe-wrapping tape.
   3. Smooth surface contours with electrical insulation putty.
   4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
   5. Band arc-proofing tape with 1”-wide bands of half-lapped, adhesive, glass-cloth tape 2” o.c.

M. Seal around cables passing through fire-rated elements according to Section 26 0593 – Electrical Systems Firestopping.

N. Install fault indicators on each phase where indicated.

O. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

P. Power-Circuit Conductor Identification: For primary conductors in vaults and manholes use color-coding conductor tape for 15kV system identification. Use metal tags to identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above. Phase identification shall be consistent throughout the system.

3.2 FIELD QUALITY CONTROL

A. Perform cable acceptance tests on cable circuits after installing cables and before electrical circuitry has been energized. Splices and terminations required as part of this project are to be completed and acceptance tested as part of cable tests. For cables not spliced or terminated as part of project, ends should be clean, dry and long enough to eliminate leakage from conductor to ground along outer surface of cable.

B. Perform acceptance tests and damage investigations under constant supervision of Owner's representative. Contractor shall coordinate and provide labor, material, equipment, and services necessary to test each completed cable circuit.

C. Remove and replace defective cables and retest as required.

D. Refer to Section 26 0812 – Power Distribution Acceptance Tests and Section 26 0813 – Power Distribution Acceptance Test Tables for visual and mechanical inspection and electrical tests. Certify compliance with test parameters.

END OF SECTION 26 0513.16
SECTION 26 05 19 - ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.
B. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW.
C. Multiconductor Cables not permitted.
D. Aluminum conductors not permitted.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Size and material per feeder schedule on plans. All conductors copper unless otherwise noted on plans.
B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway or type XHHW, single conductors in raceway.
B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.
D. Coordinate first paragraph below with Division 26 Section "Underground Ducts and Raceways for Electrical Systems."
E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

J. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least EIGHT inches of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

D. Cut sleeves to length for mounting flush with both wall surfaces.

E. Extend sleeves installed in floors 2 inches above finished floor level.

F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
1. After installing conductors and cables and before electrical circuitry has been energized, test all service entrance, switchboard, panelboard, motor or equipment feeder conductors larger than #6 AWG for compliance with requirements.


3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test Reports: Prepare a written report to record the following:

   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19
SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
B. Bare Copper Conductors:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad, zinc-coated or stainless steel; 3/4 inch by 10 feet or as otherwise accepted by local authority having jurisdiction.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, sized per plans. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded or bolted connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors in all circuits. Provide equipment grounding conductor in all armored or metalclad cable assemblies.

B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
C. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 1/0 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

D. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

E. Provide a concrete-encased ("UFER") ground. Use bare conductor no smaller than #4 AWG and encase in bottom of concrete slab or footer no less than 2" from bottom of concrete. Bond to reinforcing bars or encase at least 20' of bare conductor.
3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:

Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.

1. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
2. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26
SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes:
      1. Hangers and supports for electrical equipment and systems.
      2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS
   A. Provide supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
   B. Provide equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
   C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads imposed with a minimum structural safety factor of five times the necessary force.

1.3 SUBMITTALS
   A. Product Data: Submit product data for all proposed materials.

1.4 QUALITY ASSURANCE
   A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
   A. Do not use wooden materials for support, anchorage or attachment components unless the facility is framed of wooden materials.
   B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         a. Allied Tube & Conduit.
         b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Channel Dimensions: Selected for applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized or painted.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-plated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 40 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single or two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lbs.
D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts. Use washers.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Coordinate with general contractor for the construction of concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors (if present) will be a minimum of 10 bolt diameters from edge of the base.

B. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29
SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes raceways, fittings, boxes, floor-boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS
A. Product Data: For boxes, surface raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING
A. Rigid Steel Conduit: ANSI C80.1.
B. IMC: ANSI C80.6.
C. EMT: ANSI C80.3.
D. FMC: Zinc-coated steel.
E. LFMC: Flexible steel conduit with PVC jacket.
1. Not permitted for use as a low voltage raceway, such as serving tel/data rough-ins.
F. Fittings for Conduit (Including all types and flexible and liquid-tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
2.2 NONMETALLIC CONDUIT AND TUBING

A. Nonmetallic conduit or tubing is not permitted above-grade under any circumstance in plenums or healthcare projects unless specifically noted on plans.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper B-Line, Inc.
   2. Hoffman.
   3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, 12, or 3R, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type, screw-cover type, or flanged-and-gasketed type as necessary or as indicated on plans.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Provide 2-1/8" x 4" square boxes with mud ring for wall-mounted boxes and 2-1/8" x 4" octagonal boxes for fixture outlets.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy or aluminum, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: Not permitted unless specifically noted otherwise on plans.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel. Provide backplate.
2. Nonmetallic Enclosures: Not permitted unless noted on plans.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: EMT or RNC, Type EPC-40-PVC, as identified on plans.
   2. Concealed Conduit, Aboveground: EMT or RNC, Type EPC-40-PVC, as identified on plans.
   3. Underground Conduit: RNC, Type EPC-80 PVC, direct buried.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R unless noted otherwise on plans.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed and Subject to Severe Physical Damage: IMC. Includes raceways in the following locations:
      a. Parking Garages, stair towers.
      b. Corridors used for traffic.
   3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   5. Damp or Wet Locations: EMT.
   6. Raceways for Optical Fiber or Communications Cable: EMT.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations. See plans for specific enclosure or box specifications.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.
D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:
   1. Run conduit parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
   3. Change from ENT to IMC before rising above the floor.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in ALL empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 24 inches of slack at each end of pull wire.

K. Raceways for Optical Fiber and Communications Cable: Install as follows:
   1. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
   2. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
   1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.
   2. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
N. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit or pre-wired fixture whips for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

P. Support all wall-mounted boxes with B-Line BB8 (or equal) mounting brackets or BB4 (or equal) box support brackets. Do not use materials not specifically intended for the purpose such as scrap EMT and ty-wraps.

Q. Mark all junction boxes with panel and circuit numbers. Mark boxes of emergency systems as required by NEC 700.9. Use indelible ink.

R. Do not install boxes back to back in walls. Provide minimum 6 inch separation in non-rated walls. Provide minimum 24 inch horizontal separation in fire rated walls. In rated walls locate boxes so as to comply with IBC Section 712 separation and membrane penetration requirements. Apply fire-rated putty pads (SpecSeal Series SSP Intumescent Putty Pads, or equal) to all boxes where 24” box-to-box separation cannot be maintained or where openings exceed allowable limits under IBC section 712.

S. Wherever receptacles are shown adjacent to tel/data, video or other low voltage locations, install boxes side-by-side with a consistent distance separating the boxes of no more than 3” between adjacent faceplates. Provide or coordinate additional framing as required.

T. Coordinate all device locations with architectural elevations and other plans before rough-in. Adjust device locations to accommodate casework elevations or knee-space locations or any other architectural or other trade obstruction. Contact the architect or engineer if any conflicts are present that cannot be resolved without substantially changing the layout of devices. The contractor shall be responsible to relocate any devices that are improperly coordinated.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks or tape approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 26 05 33
SECTION 26 05 43 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 03 3000 - Cast-In-Place Concrete
B. Section 26 0543.13 - Excavation and Backfill
C. Section 26 0543.19 - Manholes and Hardware

1.2 DESCRIPTION

A. Section includes conduits, ducts, and duct accessories for concrete encased for underground primary power distribution.
B. The terms duct and duct bank, as used in this Section, are defined as follows:
   2. Duct Bank: Two or more ducts run together.

1.3 REFERENCE STANDARDS

B. ANSI C80.1 – Rigid Steel Conduit-Zinc Coated (GRC)
D. NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
E. NEMA TC2 – Electrical Polyvinylchloride (PVC) Conduit
F. NEMA TC3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing
G. NEMA TC6&8 – PVC Plastic Utilities Duct for Underground Installation
H. NEMA TC9 – Fittings for PVC Plastic Utility Duct for Underground Installation
I. NFPA 70 – National Electrical Code
J. UL 651 – Schedule 40 and 80 Rigid PVC Conduit
K. UL 651A – Type EB and A Rigid PVC Conduit and HDPE Conduit
L. ULG – Electrical Rigid Metallic Conduit-Steel
1.4 SUBMITTALS

A. Product data for the following:
   1. Duct bank materials, including spacers and miscellaneous components
   2. Ducts and conduits and their accessories, including elbows, end bells, bushings, seals, bends, fittings, plugs, pull tape, and solvent cement
   3. Warning tape

B. Manufacturer’s Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual routing of conduits and duct banks.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70
   2. Comply with ANSI C2
   3. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

B. Deliver ducts to project site with end capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.7 WARRANTY

A. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 CONDUITS

A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer, complying with NEMA TC 3 and UL 651, listed for underground use, concrete encased.

B. Size:
   1. 4” nominal for voltages above 600 V

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS
2.2 DUCT ACCESSORIES

A. Duct Spacers:
   1. Rigid PVC interlocking spacers.
   2. Factory-fabricated, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling. Horizontal and vertical locking separation between ducts as shown on drawings.

B. Elbows: Material to match conduit; minimum bend radius of 48”.

C. Bell Ends: Manufactured bell ends of appropriate sizes at each end of conduit; pre-manufactured system for PVC with conduit seals, provisions for roughing into the concrete pour and waste stops, when entering a new building or a new manhole.

D. Plugs: Closure plugs or caps of same material as conduit at ends of unused sections.

E. Pull Tape: Nylon pull tape with measurement markings in uniform lengths in each empty duct.

F. Warning tape: Permanent, bright-colored, continuous-printed, polyethylene tape with embedded continuous metallic strip or core. Not less than 6” wide by 4 mils thick.
   1. Manufacturers: Brady USA, Ideal, Marking Services, Inc. (MRI), Seton, or approved equal.

G. Concrete Dye

H. Solvent Cement: Recommended by conduit manufacturer.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate layout and installation of ducts with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct bank entrances into manholes, pad-mounted switchgear vaults and pad-mounted transformer vaults with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes, and as approved by Architect. For manholes construction, refer to Section 26 0543.19 – Manholes and Hardware.

C. Adjust the depth of electrical utilities to avoid existing utilities with no change to contract price.

D. Utility Coordination: When duct lines are being constructed for use by a utility serving the project, consult with them for duct size and quantity, minimum bending radii, maximum distance between pulling points, grounding details, termination arrangement, and other criteria.

3.2 EXISTING UTILITIES

A. The existing utilities shown on contract drawings have been plotted from available records. No guarantee is made as to accuracy of locations indicated, and is shown for the benefit of Contractor.
B. Contact all serving utility companies and have them locate their lines prior to commencing work. Coordinate with Owner all existing utility lines prior to commencing work.

C. Protect shown, visible and located utilities from damage. Promptly repair all active shown, visible and located utilities damaged by construction. This repair shall be made solely at the expense of the Contractor.

D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with Owner to shut off services if lines are active.

3.3 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Owner no fewer than 10 business days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner’s written permission.

3.4 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and away from equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer’s written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane. Do not use conduit that requires the use of couplings for straight runs.

D. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand minimum of 15 psig hydrostatic pressure. Provide watertight entrance sealing device where an underground conduit enters a structure through a concrete roof or membrane waterproofed wall or floor.

E. Pulling Cord: Install 100 lbf test nylon cord in ducts, including spares. Identify with tags at each end and at any intermediate pull point the origin and destination of each spare duct. Provide a removable permanent cap over each end of each spare duct.

F. Concrete Encased Ducts: Support ducts on duct spacers.
   1. Spacer Installation:
      a. Provide spacers close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 ft of duct. Secure spacers to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6” between tiers. Tie entire assembly together using tie wires and reinforcing steel. Install base and intermediate spacers at every coupling point of each duct line for a separation horizontally and vertically per NEC.
   2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
      a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer’s written recommendations, or use other specific measures to prevent expansion-contraction damage.
b. Terminate each pour in a vertical plane if more than one pour is necessary, and install 3/4” reinforcing rod dowels extending 18” into concrete on both sides of joint near corners of envelope. Obtain Architect’s approval for the number and location of dowels.

3. Pouring Concrete: Space concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct bank application.

4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing bars and ties without forming conductive or magnetic loops around ducts or duct groups. Size reinforcing bars and wire ties as indicated on drawings. Provide rebars with minimum of 3” of concrete on sides, top and bottom. Reinforcing bars shown in sections are required throughout.

5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms of materials and in a manner acceptable to Architect.

6. Maintain a grade of at least 4” per 100 ft, either from one manhole or pull box to the next, or from a high point between them, depending on surface contour.

7. Warning Tape: Bury warning tape approximately 12” above all concrete-encased ducts and duct banks. Align tape parallel to and within 3” of the centerline of duct bank. Provide an additional warning tape for each 12” increment of duct bank width over a nominal 18”. Space additional tapes 12” apart, horizontally.

8. Place duct banks on an undisturbed soil base if possible. Where concrete encased duct bank is installed over an extensive area of disturbed earth such that within the periphery of a building, provide a separate concrete base under the duct bank to ensure stability of raceways during installation. Allow this base to set before duct bank is installed.

G. Arrangement and Routing:

1. Arrange multiple duct runs in accordance with details shown on drawings. Locate underground ducts where indicated on drawings and grade to the elevations shown on civil drawings.

2. Make minor changes in location or cross-section as necessary to avoid obstructions or conflicts. Where duct runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, refer the condition to the Architect for written instructions before further work is done.

3. Maintain a 12” minimum vertical separation between ducts and other systems at crossings where other utility piping systems are encountered or being installed along a raceway route. Maintain a 12” minimum separation between ducts and other systems in parallel runs. Do not place ducts over valves or couplings in other piping systems. Refer conflicts with these requirements to the Architect for written instructions before further work is done.

4. Provide markers at grade to indicate direction of underground conduits provided under this contract. Provide markers consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction. Provide markers at all bends and at intervals not exceeding 100 ft in straight runs. Use markers made of sheet bronze not less than 1/4” thick embedded in and secured to the top of concrete posts. Use markers not less than 10” long and 3/4” wide and marked ELECTRIC CABLES in letters 1/4” high incised into the bronze to a depth of 3/32”.

5. Enter manholes and structures with ducts at right angles.

3.5 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600V: RNC, NEMA Type Schedule 40-PVC, in concrete encased duct bank, unless otherwise indicated.
B. Underground Ducts Crossing Paved Driveways and Roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.6 EARTHWORK

A. Excavation and Backfill: Comply with Section 26 0543.13 - Excavation and Backfill, do not use heavy-duty, hydraulic-operated compaction equipment.

3.7 CONCRETE

A. Concrete: 3000 psi, 28-day strength, complying with Division 03 - Concrete, where concrete encased.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts.
   2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80% fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Preparation for pulling in conductors:
   1. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
   2. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.

C. Do not backfill underground direct buried and concrete encased ducts until the Architect has inspected them. Notify Architect 24 h in advance of duct concrete pour, or backfill of direct buried ducts.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 26 0543
SECTION 26 05 43.13 – EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 31 2000 - Earth Moving
   B. Section 26 0543 - Underground Ducts and Raceways for Electrical Systems

1.2 DESCRIPTION
   A. Section lists methods and materials for trench excavation and backfill for electrical and communications conduits in duct banks. Refer to Section 26 0543 – Underground Ducts and Raceways for Electrical Systems.

1.3 DEFINITIONS
   A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   B. Excavation: Removal of material encountered above sub-grade elevations and to lines and dimensions indicated.
   C. Duct: A single underground conduit encased in concrete or direct buried.
   D. Duct Bank: Two or more ducts run together.
   E. Fill: Soil materials used to raise existing grades.
   F. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of fill or backfill immediately below subbase, drainage fill, or topsoil materials.
   G. Utilities: On-site underground ducts and duct banks as well as underground services within buildings.

1.4 SUBMITTALS
   A. Submit list of materials to be used for backfill.

1.5 QUALITY ASSURANCE
   A. Pre-excavation Conference: Conduct conference at project site to comply with requirements in Division 01 Section “Project Coordination.”

PART 2 - PRODUCTS

2.1 FILL MATERIAL
   A. Type 1 Fill:
      1. Material from excavation separated from materials, which do not compact by tamping and rolling. No stones larger than 3” and no building, organic, or corrosive or frozen materials and no lumps larger than 6”.
2.2 CRUSHED ROCK
   A. Crushed Rock: 1-1/4” minus, unless smaller is required for bedding material.

2.3 SAND
   A. Sand: Clean and washed building sand.

2.4 TOPSOIL
   A. Topsoil: Equal in quality to that removed.

2.5 SOD
   A. New Sod: Mature, densely rooted grass free of weeds and objectionable grasses.

2.6 PLANTS
   A. Plants: Obtained from a commercial nursery and be similar to those replaced.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Establish grade lines and locations of roadways and sidewalks, grade beams, and pill caps. Provide necessary stakes and batter boards.

   B. Verify elevations of existing utilities prior to excavation for new ducts.

   C. Verify locations of vaults and manholes with civil drawings

   D. Coordinate excavation and backfill with Section 31 2000 – Earth Moving.

3.2 EXCAVATION
   A. Provide excavation for underground work, including ducts, vaults, manholes, unless otherwise shown or specified.

   B. Excavate trench to 24” wider than duct or duct bank dimensions and minimum of 3” below bottom of duct.
C. Include clearing, tree removal, grubbing, pavement removal, substructure removal such as walls, footings, and piers, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, and transportation. Coordinate excavation extending beyond construction limits with Construction Manager and Owner.

D. Do not provide blasting on this project without written permission of Architect and Owner.

E. Dispose of excess excavation material on site in location designated by Construction Manager.

F. Over excavate 3" and fill with 3" of sand, where trench bottom is rock, or rocky, or contains debris larger than 1", or material with sharp edges.

G. Perform all crossings of concrete or asphalt after surface material has been saw cut to required width and removed.

H. Conform to utility company requirements for excavation and vault installation in addition to contract document requirements where excavations are for installing utility company’s ducts and vaults.

3.3 ROCK EXCAVATION

A. Use mechanical methods to remove rock in trenches for underground ducts.

B. Refer to Geotechnical Report available from Architect/Engineer for data on rock.

C. Include rock excavation in the Bid, unless otherwise indicated.

3.4 INSTALLATION

A. Keep underground ducts to proper line and grade and sealed to prevent entrance of animals or foreign matter.

B. Provide bracing and sheet piling as necessary to support trenches. Comply with Local Regulations, applicable provisions of OSHA Regulations on trenching, or with provisions of “Manual of Accident Prevention in Construction” published by Associated General Contractors of America.

C. Do not lay duct in water.

D. Keep trench free from water until duct joint material has hardened and concrete encasement is in place.

E. Do not increase the contract cost due to presence of ground water in soil or necessity of sheet piling or bracing trenches. Adjust contract cost when sheet piling is left in place, on written order of Owner.

F. Do not remove sheet piling until trench is substantially backfilled. Cut off sheet piling left in place not less than 2 ft below new, finished grade.

G. Place underground ducts on 3” compacted bedding of sand. Shape bedding for clearance for joints and fittings, tamped in place and graded evenly to ensure uniform bearing for the full length of duct. Do not support duct by blocking, planking or mounding of bedding material.

H. Install lines passing under foundations with minimum of 3” clearance to concrete and ensure there is no disturbance of bearing soil.
3.5 BACKFILL

A. Backfill around ducts by hand to depth of 12” above top of duct with specified fill in 6” layers. Compact backfill thoroughly with compactor of suitable weight or with approved mechanical tamper. Do not use flooding or jetting with water.

B. Place backfill from 12” above duct to elevation of subgrade in layers not exceeding 8” in depth with specified fill.

C. Backfill from 12” above duct to sub-grade with specified fill, when excavating through areas which are to become walks, roads, driveways or parking areas of concrete, bituminous or exposed gravel surfacing or such areas are existing to remain. Backfill in 12” layers and compact with mechanical means to density 95% modified proctor.

D. Conform excavation, duct laying, backfilling, grading and surfacing, as herein specified, when excavation occurs on public property or areas beyond the property line. Comply with additional requirements for public utility or other authorities. Check with each utility and incorporate cost of any additional requirements in base bid.

E. Backfill around vaults to be free of debris larger than 1-3/4” in all directions to 1 ft from vault.

F. Provide 6” of pea gravel or sand bedding for vaults.

G. Other backfill shall be free of debris larger than 6” in diameter.

H. Place backfill material so as to obtain a minimum degree of compaction of 95% of maximum density at optimum moisture content. Moisten backfill material as required to obtain proper compaction.

I. Broken pavement, concrete, sod, roots, and debris shall not be used for backfill.

3.6 DEWATERING

A. Provide, operate, and maintain all pumps or other dewatering equipment required for control of water in trenches and excavations for electrical and communications site work during the entire construction period.

3.7 SHORING

A. Provide as required by trenching and excavating to secure site work. Comply with applicable safety regulations.

3.8 FINISHING

A. On completion of trenching and backfilling operations, restore grades to original elevation or to new sub-grade elevation.

B. Replace surfaces to existing conditions when trenching is through existing areas or beyond construction limits.

C. Use 6” of topsoil and sod to match existing elevations in landscaped areas or as otherwise approved by Landscape Architect.
3.9 SURFACE FINISHING

A. Refinish every disturbed surface to its original condition.

B. Replace planted materials not surviving 90 days after contract acceptance at Contractor's own expense.

C. Return after 1 year and re-fill, compact and refinish settled areas to grade.

3.10 CARE OF PLANTS AND TREES

A. Remove and safely store plants and trees with trunks smaller than 6” diameter prior to commencing site work. Avoid trees larger than 6” diameter when so indicated on drawings. Replace plants and trees upon completion of site work.

END OF SECTION 26 0543.13
SECTION 26 05 43.19 – MANHOLES AND HARDWARE

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 26 0543 – Underground Ducts and Raceways for Electrical Systems
B. Section 26 0543.13 – Excavation and Backfill

1.2 DESCRIPTION

A. Section includes underground utility structures: vaults, manholes and accessories for power cable systems.

1.3 REFERENCED STANDARDS

A. AASHTO HB 17 – Standard Specifications for Highway Bridges
B. ANSI C2 – National Electrical Safety Code
C. ASTM A 48/A 48M – Specification for Gray Iron Castings
D. ASTM C 270 – Specification for Mortar for Unit Masonry
E. ASTM C 387 – Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
F. ASTM C 858 – Specification for Underground Precast Concrete Utility Structures
G. ASTM C 891 – Standard Practice for Installation of Underground Precast Concrete Utility Structures
H. ASTM C 1037 – Practice for Inspection of Underground Precast Concrete Utility Structures
J. ISO 9000 – Quality Management
K. ISO 10012 – Measurement Management Systems
L. NFPA 70 – National Electrical Code
M. SCTE 77 – Specification for Underground Enclosure Integrity

1.4 SUBMITTALS

A. Product Data:
   1. Accessories for underground utility structures.
B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes
   2. Reinforcement details
   3. Frame and cover design and manhole frame support rings
   4. Ladder details
   5. Grounding details
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps
   7. Joint details

C. Product Certificates: For concrete and steel used in precast concrete vaults and manholes, as required by ASTM C 858.

D. Field quality-control test reports.
   1. Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

E. Manufacturer’s Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual location of underground utility structures.
   2. Operation and Maintenance Data:
      a. Include manufacturer’s recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.
      b. Include spare parts data listing, source, and current prices of replacement parts and supplies.

1.5 QUALITY ASSURANCE

A. Comply with ANSI C2
B. Comply with NFPA 70

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store precast concrete and other factory-fabricated underground utility structures at project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

B. Life and support precast concrete units only at designated lifting or supporting points.

1.7 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.
B. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE VAULTS AND MANHOLES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom. Frame and cover shall form top of enclosure and shall have load rating consistent with that of vault and manhole.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carder Concrete Products
   2. Christy Concrete Products
   3. Elmhurst-Chicago Stone Co.
   4. Oldcastle Precast Group
   5. Riverton Concrete Products; a division of Cretex Companies, Inc.
   6. Utility Concrete Products, LLC.
   8. Wausau Tile, Inc.
   9. Jensen Precast

C. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.
   1. Duct Entrances in Vault and Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
      a. Type and size: Fittings matched to duct or conduit to be terminated.
      b. Fittings: Aligned with elevations of approaching ducts and located near interior corners of vaults and manholes to facilitate racking of cable.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the groundwater level at grade.

2.2 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Bilco Company (The)
   2. Campbell Foundry Company
   3. Carder Concrete Products
   4. Christy Concrete Products
   5. East Jordan Iron Works, Inc.
   7. Jensen Precast
   8. McKinley Irion Works, Inc.
   9. Neenah Foundry Company
   10. NewBasis
   11. Oldcastle Precast Group
13. Pennsylvania Insert Corporation
14. Riverton Concrete Products; a division of Cretex Companies, Inc.
15. Strongwell Corporation; Lenoir City Division
17. Utility Concrete Products, LLC.
18. Utility Vault Co.
19. Wausau Tile, Inc.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surface; diameter as indicated on drawings.
   a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Cast in. Selected to suit system.
   a. Legend: “ELECTRIC” for duct systems with medium-voltage cables.
3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 ft³ where packaged mix complying with ASTM C 387, Type M, may be used.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2” diameter eye, and 1” x 4” bolt.

D. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts for noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2” ID by 2-3/4” deep, flared to 1-1/4” minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

E. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.
1. Stanchions: T-section or channel; 2-1/4” nominal size; punched with 14 holes on 1-1/2” centers for cable-arm attachment.
2. Arms: 1-1/2” wide, lengths ranging from 3” with 450 lb minimum capacity to 18” with 250 lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.

F. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

G. Fixed Manhole Ladders: Arranged for attachment to roof or wall and floor of manhole. Ladder, mounting brackets and braces: Fabricated from hot-dip galvanized steel.

H. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Minimum two required.

2.3 SOURCE QUALITY CONTROL
A. Test and inspect precast concrete utility structures according to ASTM C 1037.
PART 3 - EXECUTION

3.1 UNDERGROUND ENCLOSURE APPLICATION

A. Manholes: Precast concrete:
   1. Manholes Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.2 INSTALLATION OF CONCRETE VAULTS AND MANHOLES

A. Precast Concrete Vault and Manhole Installation
   1. Comply with ASTM C 891, unless otherwise indicated.
   2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
   3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1" sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
   4. Concrete: 5000 psi 28-day strength, complying with Division 03 – Concrete.

B. Elevations:
   1. Vault and Manhole Roof: Install with rooftop as indicated on drawings.
   2. Manhole Frame: In paved areas and traffic-ways, set frames flush with finished grade. Set other manhole frames 1" above finished grade.

C. Manhole Access: Circular opening in manhole roof; sized to match cover size.
   1. Manhole with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
   2. Install chimney, constructed of precast concrete collars and rings, to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

D. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

E. Pack and smooth non-shrink grout at all rough edges around duct entrances at each vault and manhole.

3.3 GROUNDING

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes: Install a driven ground rod through manhole floor, close to wall, and set rod depth so 4" will extend above finished floor. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2" above to 6" below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, catch basins, metallic cover frame and cable shields within each manhole, to ground rod or grounding conductor. Make connections with #4 AWG minimum, stranded, copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground utility structures.
   2. Test vault and manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Interpret test results in writing and submit to Engineer.

3.5 CLEANING

A. Clean internal surfaces of vaults and manholes, including sump and remove foreign material, after completing the installation of all devices, equipment, cables and terminations.

B. Remove water from vaults and manholes. If vaults and manholes continue to fill up with water, Contractor shall pump them regularly until the source of water has been detected and corrected.

END OF SECTION 26 0543.19
SECTION 26 05 48 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Restraint channel bracings.
   2. Restraint cables.
   4. Mechanical anchor bolts.
   5. Adhesive anchor bolts.

B. Related Requirements:
   1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.
   1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
      a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS
   A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
   B. Qualification Data: For professional engineer and testing agency.
   C. Welding certificates.
   D. Field quality-control reports.

1.5 QUALITY ASSURANCE
   A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.
   B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
   C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
   E. Comply with NFPA 70.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Design Category, Occupancy Category: See Structural.
   2. Component Importance Factor: 1.5.
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): See Structural.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper B-Line, Inc.; a division of Cooper Industries.
   2. Hilti, Inc.
   3. Mason Industries, Inc.
   4. Unistrut; an Atkore International company.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Kinetics Noise Control, Inc.
   2. Loos & Co., Inc.
   3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Cooper B-Line, Inc.; a division of Cooper Industries.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
   4. TOLCO; a brand of NIBCO INC.
B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hilti, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.6 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete." and/or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

B. Equipment and Hanger Restraints:
   1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the
structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.


4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

B. Seismic controls will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48
SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Identification for conductors and communication and control cable.
   2. Warning labels and signs.
   3. Equipment identification labels.

1.2 SUBMITTALS
A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE
A. Comply with ANSI A13.1.

1.4 COORDINATION

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS
A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS
B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 7 by 10 inches.
D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

F. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES".

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

PART 3 - EXECUTION

3.1 APPLICATION

A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and cable pull points. Identify by system and circuit designation.
2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply metal-backed, butyrate warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Adhesive film label with clear protective overlay or self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where 2 lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
   c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
   d. All labels to include equipment tag (e.g. HWP-1), equipment description (e.g. HOT WATER PUMP 1), voltage and phase (e.g. 208V 3-Ø), and panel and circuit number of source (e.g. 1N1L-23/25/27).
   e. All labels shall be black letters on white background.

2. Equipment to Be Labeled:
   a. Panelboards, electrical cabinets, and enclosures.
   b. Electrical switchgear and switchboards.
   c. Transformers.
   d. Motor-control centers.
   e. Disconnect switches.
   f. Enclosed circuit breakers.
   g. Motor starters.
   h. Push-button stations.
   i. Power transfer equipment.
   j. Contactors.
   k. Lighting controls
   l. Fire Alarm Control Panel
   m. Heat Tape components

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors in all cases where the insulation of the wire is not color coded.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.

END OF SECTION 26 05 53
SECTION 26 05 72 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

B. Study shall be conducted by the overcurrent protective device manufacturer.

1.2 ACTION SUBMITTALS

A. Other Action Submittals: Submit the following prior to the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

   a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

   b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

   c. Provide recommendations for alternate devices and equipment to meet short-circuit requirements.

1.3 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. Power Analytics, Corporation.
6. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.


G. Short-Circuit Study Output:
1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:
      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.
   1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
   2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study:
   1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Obtain electrical power utility impedance at the service.
   3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the primary side of the main transformer, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
   1. Electric utility's supply termination point.
   2. Incoming switchgear.
   3. Low-voltage switchgear.
   4. Motor-control centers.
   5. Control panels.
   6. Automatic transfer switches.
   8. Disconnect switches.
3.3 ADJUSTING
   A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 REPEATING STUDY
   A. Repeat study up to two additional times after adjustments are made to the equipment.

3.5 DEMONSTRATION
   A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 26 05 72
SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1. Study results shall be used to determine coordination of series-rated devices.

B. Study shall be conducted by the overcurrent protective device manufacturer.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.

2. Study and equipment evaluation reports.

3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing,
obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Provide recommendations for alternate devices and equipment to meet short-circuit requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. The following parts from the Protective Device Coordination Study Report:

   1) One-line diagram.
   2) Protective device coordination study.
   3) Time-current coordination curves.

b. Power system data.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

   1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. Power Analytics, Corporation.
6. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:
   a. Arcing faults.
   b. Simultaneous faults.
   c. Explicit negative sequence.
   d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study:
   1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:
      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
   c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
   1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
   2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

4. Plot the following listed characteristic curves, as applicable:

   a. Power utility's overcurrent protective device.
   b. Medium-voltage equipment overcurrent relays.
   c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
   d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
   e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
   f. Cables and conductors damage curves.
   g. Ground-fault protective devices.
   h. Motor-starting characteristics and motor damage points.
   i. Generator short-circuit decrement curve and generator damage point.
   j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.

6. Provide adequate time margins between device characteristics such that selective operation is achieved.

7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

      1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

   A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

   B. Comply with IEEE 399 for general study procedures.

   C. The study shall be based on the device characteristics supplied by device manufacturer.

   D. The extent of the electrical power system to be studied is indicated on Drawings.

   E. Begin analysis at the primary side of the service transformer, extending down to the system overcurrent protective devices as follows:
1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to, the following:
   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY


M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Generator thermal-damage curve.
   e. Ratings, types, and settings of utility company's overcurrent protective devices.
   f. Special overcurrent protective device settings or types stipulated by utility company.
   g. Time-current-characteristic curves of devices indicated to be coordinated.
   h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
   k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.4 REPEATING STUDY

   A. Repeat study up to two additional times after adjustments are made to the equipment.

3.5 FIELD ADJUSTING

   A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

   B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

END OF SECTION 26 05 73
SECTION 26 05 74 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.
   B. Study shall be conducted by the overcurrent protective device manufacturer.

1.2 ACTION SUBMITTALS
   A. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.
      1. Arc-flash study input data, including completed computer program input data sheets.
      2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
         a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.3 CLOSEOUT SUBMITTALS
   A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
   B. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.4 QUALITY ASSURANCE
   A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
   B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
      1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. Power Analytics, Corporation.
6. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
5. Working distance.
6. Incident energy.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3.5-by5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
5. Incident energy.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.
3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the primary side of the service transformer, extending down to the system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 10 kA or less.
   2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors and shall apply to low-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
   1. Electric utility's supply termination point.
   2. Switchgear.
   3. Low-voltage switchgear.
   4. Motor-control centers.
   5. Standby generators and automatic transfer switches.

3.3 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.
   1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
   2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
5. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
6. Motor horsepower and NEMA MG 1 code letter designation.
7. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.5 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.6 APPLICATION OF WARNING LABELS

A. Install the arc-flash warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.7 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 26 05 74
SECTION 26 08 12 – POWER DISTRIBUTION ACCEPTANCE TESTS

PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0513.16 – Medium-Voltage, Single- and Multi-Conductor Cables
   B. Section 26 0813 – Power Distribution Acceptance Test Tables
   C. Section 26 1219 – Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers

1.2 DESCRIPTION
   A. Section includes acceptance testing requirements for assessing the suitability for service and reliability of the power distribution system.
   B. Contractor to ensure all tested electrical equipment, both contractor and Owner supplied, is operational and within industry and manufacturer’s tolerances and is installed in accordance with design specifications.
   C. Tests and inspections shall be performed after installation.
   D. Tests and inspections shall determine suitability for energization.
   E. Electrical systems shall pass tests prior to substantial completion or Owner occupancy.
   F. This specification requires contractor to engage services of testing agency.
   G. All tests tables referenced in this specification provided in Section 26 0813 – Power Distribution Acceptance Test Tables.
   H. Items to be tested and inspected as follows:
      1. 15kV primary cable and terminations
      2. Liquid filled transformers
         a. One 150kVA, 12.47kV – 480Y/277 V pad mounted transformers
      3. Thermographic survey

1.3 REFERENCE STANDARDS
   B. ANSI/IEEE C57 – Distribution, Power, and Regulating Transformers
   C. ANSI/IEEE C57.104 – Guide for the Interpretation of Gases Generated in Oil-immersed Transformers
   D. ANSI/IEEE Std. 48 – Standard Test Procedure and Requirements for High-Voltage Alternating-Current Cable Terminations
E. ANSI/IEEE Std. 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

F. ANSI/IEEE Std. 141 – IEEE Recommended Practice for Electrical/Power Distribution for Industrial Plants (IEEE Red Book)


I. ANSI/IEEE Std. 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)


K. ANSI/IEEE Std. 400 – Guide for Making High-Direct-Voltage Tests on Power Cable Systems in the Field


N. ANSI/IEEE Std. 1100 – IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE Emerald Book)


P. ASTM D3612 – Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography

Q. ASTM D3613 – Standard Practice for Sampling Insulating Liquids for Gas Analysis and Determination of Water Content

R. NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

S. NEMA MG1 – Motors and Generators

T. NFPA 70 – National Electrical Code

U. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance

V. NFPA 70E – Electrical Safety Requirements for Employee Workplaces

W. NIST – National Institute of Standards and Technology

1.4 SUBMITTALS

A. Test Reports: Include the following:
   1. Summary of project
   2. Description of equipment tested
   3. Equipment used to conduct the test
   4. Description of test
   5. Test results, as compared to manufacturers’ or industry accepted standards and tolerances
   6. Conclusions and recommendations
   7. Signature of responsible test organization authority

B. List of equipment used to perform tests. Identify the following:
   1. Type
   2. Manufacturer
   3. Model number
   4. Serial number
   5. Date of last calibration
   6. Documentation of calibration leading to NIST standards

1.5 QUALITY ASSURANCE

A. Qualifications of Testing Agency:
   1. Testing firm shall be a corporately and financially independent testing organization that can function as an unbiased testing authority, professionally independent of the manufacturer, supplier, and installers of equipment or system evaluated by the testing firm.
   2. Testing firm shall be regularly engaged in testing of electrical equipment, devices, installations and systems.
   3. Testing firm shall meet Federal Occupational Safety and Health Administration (OSHA) requirements for accreditation of independent testing laboratories.
   4. On-site technical person shall be currently certified by the International Electrical Testing Association in electrical power distribution system testing.
   5. Testing firm shall use technicians who are regularly employed by the firm for testing services.
   6. Testing firm shall submit proof of above qualifications with bid documents when requested.

PART 2 - PRODUCTS

2.1 NOT APPLICABLE TO THIS SECTION.

PART 3 - EXECUTION

3.1 PREPARATION

A. Documentation: Deliver the following to testing firm, minimum two weeks prior to commencement of testing:
   1. Complete set of electrical plans and specifications, with available short circuit indicated on power riser diagrams.
   2. Approved submittals and shop drawings of equipment being tested.
   3. Pertinent change orders.
3.2 FIELD QUALITY CONTROL

A. Inspection and Test Procedures: Comply with NETA.
1. Medium-Voltage Cables:
   a. Visual and Mechanical Inspection:
      1) Compare cable date with drawings and specifications.
      2) Inspect exposed sections of cables for physical damage.
      3) Verify tightness of accessible bolted connections by calibrated torque wrench in accordance with manufacturer's published data or Table 12.
      4) Perform thermographic survey of all terminations and splices in accordance with paragraph "Thermographic Survey."
      5) Inspect compression-applied connectors for correct cable match and indentation.
      6) Inspection for grounding, cable support, and termination.
      7) Verify visible cable bends meet or exceed ICEA and manufacturer's minimum allowable bending radius.
      8) Inspect for adequate arc proofing in common cable areas, if specified.
      9) Inspect jacket and insulation condition.
     10) Inspect for correct identification and arrangements.
   b. Electrical Tests:
      1) Perform concentric neutral-continuity test on each power cable by ohmmeter method and record value.
      2) Perform insulation-resistance test using megohm meter with voltage output of at least 2500 V. Individually test each conductor with other conductors and concentric neutral grounded. Test duration shall be 1 minute.
      3) Perform DC high-potential test on cables, including terminations and joints after cable system installation and before placing cable in service. Adhere to precautions and limits as specified in applicable NEMA/ICEA Standards for the specific cable. Perform tests in accordance with ANSI/IEEE Standard 400. Test voltages shall not exceed 80% of cable manufacturer's factory test value or maximum test voltage in Table 6.
         a) Insure input voltage to test set is regulated.
         b) Current-sensing circuits in test equipment shall measure only leakage current associated with cable under test and shall not include internal leakage of test equipment.
         c) Record wet- and dry-bulb temperatures or relative humidity and temperature.
         d) Test each section of cable individually.
         e) Individually test each conductor with other conductors grounded. Ground concentric neutrals.
         f) Terminations shall be adequately corona-suppressed by guard ring, field reduction sphere, or other suitable method as necessary.
         g) Insure maximum test voltage does not exceed limits for terminators specified in ANSI/IEEE Standard 48 or manufacturer's specifications.
         h) Apply DC high-potential test in at least 5 equal increments until maximum test voltage is reached. No increment shall exceed voltage rating of the cable.
Record DC leakage current at each step after constant stabilization time consistent with system charging current.

i) Raise conductor to specified maximum test voltage and hold for 15 minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter.

j) Reduce conductor test potential to zero and measure residual voltage at discrete intervals.

k) Apply grounds for time period adequate to drain insulation stored charge.

4) Perform high voltage phase test after successful completion of continuity and high potential tests. Testing agent shall conduct a high voltage phase test at normal line voltage to verify that segments of the system can be paralleled together.

c. Test Values:
1) Concentric neutral must exhibit continuity. Investigate resistance values in excess of 10 ohms per 1000 ft of cable.

2) Graphic plots may be made of leakage current versus step voltage at each increment and leakage current versus time at final test voltages.
   a) Step voltage slope should be reasonably linear.
   b) Capacitive and absorption current should decrease continually until steady state leakage is approached.

2. Liquid Filled Transformers:
a. Visual and Mechanical Inspection:
1) Compare equipment nameplate data with drawings and specifications.

2) Inspect physical and mechanical condition for physical damage, cracked insulators, and tightness of connection.

3) Verify removal of shipping bracing after final placement.

4) Inspect impact recorder prior to unloading, if applicable.

5) Verify alarm, control, and trip settings on temperature and level indicators are as specified.

6) Verify operation of alarm, control, and trip circuits from temperature and level indicators, pressure relief device, and fault pressure relay.

7) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer’s published data or Table 12.

8) Perform thermographic survey in accordance with paragraph “Thermographic Survey.”

9) Verify correct liquid level in tanks and bushings.

10) Perform specific inspections and mechanical tests as recommended by manufacturer.

11) Verify correct equipment grounding.

b. Electrical Tests:
1) Perform insulation-resistance tests, winding-to-winding and each winding-to-grounding with test voltage in accordance with Table 5. Test duration shall be for 10 minutes with resistance tabulated at 30 seconds, 1 minute, and 10 minutes.

2) Calculate polarization index.

3) Perform a turns-ratio test on no-load tap-changer positions and load tap-changer positions. Verify tap setting is as specified. Verify winding polarities are in accordance with nameplate.

4) Perform insulation power-factor/dissipation-factor tests on windings and correct to 68°F in accordance with test equipment manufacturer’s instructions.

5) Perform power-factor/dissipation-factor tests (or hot collar watts-loss tests) on bushings and correct to 68°F in accordance with test equipment manufacturer’s instructions.

6) Remove sample of insulating liquid in accordance with ASTM D923. Sample shall be tested for the following:
   a) Dielectric breakdown voltage: ASTM D877 and/or ASTM D1816.
b) Acid neutralization number: ASTM D974.

c) Specific gravity: ASTM D1298.

d) Interfacial tension: ASTM D971 or ASTM D2285.

e) Color: ASTM D1500.


g) Measure dissipation factor or power factor in accordance with ASTM D924.

7) Remove sample of insulating liquid in accordance with ASTM D3613 and perform dissolved gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D3612.

c. Test Values:

1) Bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by manufacturer.

2) Insulation-resistance test values at one minute should not be less than values recommended in Table 5. Resistance values to be temperature corrected in accordance with Table 14.

3) Polarization index should be compared to manufacturer’s factory test results. If manufacturer’s data is not available, acceptance test results will serve as baseline data.

4) Turns-ratio test results shall not deviate more than 0.5% from either the adjacent coils or the calculated ratio.

5) Maximum power factor of liquid-filled transformers corrected to 68°F shall be in accordance with transformer manufacturer’s published data. Representative values are shown in Table 3. Compare with test equipment manufacturer’s published data.

6) Investigate bushing power factors and capacitances that vary from nameplate values by more than 10%. Investigate any bushing hot collar watts-loss results that exceed test equipment manufacturer’s published data.

7) Typical excitation-current test data pattern for three-legged core transformer is two similar current readings and one lower current reading.

8) Consult manufacturer if winding-resistance measurements vary more than 1% from adjacent windings.

9) Consult manufacturer if core insulation is less than one megohm at 500 VDC.

10) Insulating liquid shall comply with Table 4.

11) Evaluate results of dissolved-gas analysis in accordance with IEEE Standard C57.104. Use results as baseline for future tests.

3. Thermographic Survey:

a. Visual and Mechanical Inspection:

1) Inspect physical, electrical, and mechanical conditions.

2) Remove all necessary covers prior to thermographic inspection.

3) Equipment to be inspected shall include all current-carrying devices. Provide report including the following:

a) Discrepancies.

b) Temperature difference between area of concern and reference area.

c) Cause of temperature difference.

d) Areas inspected. Identify inaccessible and unobservable areas and equipment.

e) Identify load conditions at time of inspection.

f) Provide photographs and thermogram of deficient area.

b. Test Parameters:

1) Inspect distribution systems with imaging equipment capable of detecting minimum temperature difference of 2°F at 86°F.

2) Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3) Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Refer to NFPA 70B, Section 20.17 (Infrared Inspection).

c. Test Results:
   1) Temperature differences of 2°F to 5 °F indicate possible deficiency and warrant investigation.
   2) Temperature differences of 7°F to 27°F indicate deficiency; repair as time permits.
   3) Temperature differences of 29°F and above indicate major deficiency; repair immediately.
   4) Suggested actions based on temperature rise can be found in Table 18.

B. Test Reports:
1. Testing firm shall do the following:
   a. Prepare test report, including description of equipment tested, description of test, test results, conclusions and recommendations, retesting results, list of test equipment used and calibration date.
   b. Show test results in comparison to industry and manufacturer’s values and tolerances.
   c. Interpret test results in writing and give recommendations for acceptance or rejection upon consultation with Engineer and prior to energizing equipment.
   d. Assure electrical equipment is operational and within industry and manufacturer’s tolerances, and is installed in accordance with contract documents.
   e. Assure suitability of energization.
   f. Report to the Owner and Engineer any system, material, or workmanship that is found defective on the basis of acceptance tests.
   g. Retest equipment when required.
   h. Maintain written record of tests.
   i. Utilize safety practices during the tests in accordance with:
      1) Acceptable state and local safety operating procedures
      2) Owner’s safety practices
      3) OSHA
      4) NFPA 70E
   j. Perform tests with apparatus de-energized and grounded, except where otherwise specifically required ungrounded by test procedures.
   k. Assemble and certify final test report.
   l. Provide 4 copies of complete test report.
   m. Attach label to all tested equipment with indication of date tested and testing firm name.

2. Contractor shall do the following:
   a. Investigate, replace, or repair any fault in material or in any part of the installation revealed by the tests.
   b. Deliver one copy of each test report directly to Engineer within 30 days after completion of testing, unless directed otherwise. Insert a copy of each test report in the equipment operation and maintenance manuals.

C. Test Equipment:
1. Test Instrument Calibration:
   a. Testing firm shall have calibration program that assures test instruments are maintained with rated accuracy.
   b. Instruments shall be calibrated in accordance with the following frequency schedule:
      1) Field instruments: Analog, 6 months maximum; Digital, 12 months maximum
      2) Laboratory instruments: 12 months
      3) Leased specialty equipment: 12 months where accuracy is guaranteed by lessor
   c. Dated calibration labels shall be visible on test equipment.
   d. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
e. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.

f. Equipment used for field testing shall be more accurate than instrument being tested.

g. Calibrating standard applied to testing equipment shall be of higher accuracy than instrument tested.
SECTION 26 08 13 – POWER DISTRIBUTION ACCEPTANCE TEST TABLES

TABLE 3
Recommended Dissipation Factor/Power Factor at 20°C
Liquid Filled Transformers, Regulators, and Reactors
Acceptance Test Values

<table>
<thead>
<tr>
<th></th>
<th>Oil, Silicone, and Less-Flammable Hydrocarbon Maximum Value (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Power Transformers and Reactors</td>
<td>0.5%</td>
</tr>
<tr>
<td>New Distribution Transformers and Regulators</td>
<td>1.0%</td>
</tr>
<tr>
<td>Remanufactured Power Transformers and Reactors</td>
<td>1.0%</td>
</tr>
<tr>
<td>Remanufactured Distribution Transformers and Regulators</td>
<td>1.5%</td>
</tr>
</tbody>
</table>
### Table 4.1
#### Test Limits for New Insulating Oil Received in New Equipment

<table>
<thead>
<tr>
<th>Test</th>
<th>ASTM Method</th>
<th>Acceptable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric breakdown, kV minimum</td>
<td>D877</td>
<td>30</td>
</tr>
<tr>
<td>Dielectric breakdown, kV minimum @ 1 mm(0.04&quot;) gap</td>
<td>D1816</td>
<td>25</td>
</tr>
<tr>
<td>Dielectric breakdown, kV minimum @ 2 mm(0.08&quot;) gap</td>
<td>D1816</td>
<td>45</td>
</tr>
<tr>
<td>Interfacial tension mN/m minimum</td>
<td>D971 or D2285</td>
<td>38</td>
</tr>
<tr>
<td>Neutralization number, mg KOH/g maximum</td>
<td>D974</td>
<td>0.015</td>
</tr>
<tr>
<td>Water content, (ppm) maximum</td>
<td>D1533</td>
<td>20</td>
</tr>
<tr>
<td>Power factor at 25°C, %</td>
<td>D924</td>
<td>0.05</td>
</tr>
<tr>
<td>Power factor at 100°C, %</td>
<td>D924</td>
<td>0.40</td>
</tr>
<tr>
<td>Color</td>
<td>D1500</td>
<td>1.0</td>
</tr>
<tr>
<td>Visual condition</td>
<td>D1524</td>
<td>Bright and clear</td>
</tr>
</tbody>
</table>


### Table 4.2
#### Test Limits for Silicone Insulating Liquid in New Transformers

<table>
<thead>
<tr>
<th>Test</th>
<th>ASTM Method</th>
<th>Acceptable Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric breakdown, kV minimum</td>
<td>D877</td>
<td>30</td>
</tr>
<tr>
<td>Visual</td>
<td>D2129</td>
<td>clear, free of particles</td>
</tr>
<tr>
<td>Water content, (ppm) maximum</td>
<td>D1533</td>
<td>50</td>
</tr>
<tr>
<td>Dissipation/power factor, 60 Hz, % max. @ 25°C</td>
<td>D924</td>
<td>0.1</td>
</tr>
<tr>
<td>Viscosity, cSt @ 25°C</td>
<td>D445</td>
<td>47.5 – 52.5</td>
</tr>
<tr>
<td>Fire point, °C, minimum</td>
<td>D92</td>
<td>340</td>
</tr>
<tr>
<td>Neutralization number, mg KOH/g max.</td>
<td>D974</td>
<td>0.01</td>
</tr>
</tbody>
</table>

### Insulating Fluid Limits

#### Table 4.3

Typical Values for Less-Flammable Hydrocarbon Insulating Liquid

Received in New Equipment

<table>
<thead>
<tr>
<th>ASTM Method</th>
<th>Test</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
</tr>
<tr>
<td>D1816</td>
<td>Dielectric breakdown voltage for 2 mm (0.08&quot;) gap, kV</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34.5 kV class and below</td>
</tr>
<tr>
<td>D1816</td>
<td>Dielectric breakdown voltage for 1 mm (0.04&quot;) gap, kV</td>
<td>20</td>
</tr>
<tr>
<td>D974</td>
<td>Neutralization number, mg KOH/g</td>
<td>0.03</td>
</tr>
<tr>
<td>D877</td>
<td>Dielectric breakdown voltage kV</td>
<td>30.30</td>
</tr>
<tr>
<td>D924</td>
<td>AC loss characteristic (dissipation factor), %</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>25°C</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>100°C</td>
<td>----</td>
</tr>
<tr>
<td>D1533B</td>
<td>Water content, (ppm)</td>
<td>25</td>
</tr>
<tr>
<td>D1524</td>
<td>Condition-visual</td>
<td>Clear</td>
</tr>
<tr>
<td>D92</td>
<td>Flash point (°C)</td>
<td>275</td>
</tr>
<tr>
<td>D92</td>
<td>Fire point (°C)</td>
<td>300°a</td>
</tr>
<tr>
<td>D971</td>
<td>Interfacial tension, mN/m, 25°C</td>
<td>38</td>
</tr>
<tr>
<td>D445</td>
<td>Kinematic viscosity, mm²/s. (cSt), 40°C</td>
<td>1.0 x 10²(100)</td>
</tr>
<tr>
<td>D1500</td>
<td>Color</td>
<td>L2.5</td>
</tr>
</tbody>
</table>


The test limits shown in this table apply to less-flammable hydrocarbon fluids as a class. Specific typical values for each brand of fluid should be obtained from each fluid manufacturer.

a. If the purpose of the HMWH installation is to comply with the NFPA 70 *National Electrical Code*, this value is the minimum for compliance with NEC Article 450.23.
### TABLE 5
Transformer Insulation-Resistance
Acceptance Test Voltage and Minimum Results

<table>
<thead>
<tr>
<th>Transformer Coil Rating Type in Volts</th>
<th>Minimum DC Test Voltage</th>
<th>Recommended Minimum Insulation Resistance in Megohms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liquid Filled</td>
</tr>
<tr>
<td>0 - 600</td>
<td>1000</td>
<td>100</td>
</tr>
<tr>
<td>601 - 5000</td>
<td>2500</td>
<td>1000</td>
</tr>
<tr>
<td>5001 - 15000</td>
<td>5000</td>
<td>5000</td>
</tr>
</tbody>
</table>

See Table 14 for Temperature Correction Factors.

NOTE: Since insulation resistance depends on insulation rating (kV) and winding capacity (kVA), values obtained should be compared to manufacturer's test data.
### TABLE 6
Medium-Voltage Cables
Acceptance Test Values

<table>
<thead>
<tr>
<th>Rated Voltage Phase-to-Phase kV</th>
<th>Conductor Sizes</th>
<th>Nominal Insulation Thickness mils (mm)</th>
<th>Maximum DC Field Test Voltages, kV During/After Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AWG or kcmil (mm)</td>
<td>100% Insulation Level</td>
<td>133% Insulation Level</td>
</tr>
<tr>
<td>5</td>
<td>8-1000 (8.4-507)</td>
<td>90 (2.29)</td>
<td>115 (2.92)</td>
</tr>
<tr>
<td></td>
<td>Above 1000 (507)</td>
<td>140 (3.56)</td>
<td>140 (3.56)</td>
</tr>
<tr>
<td>8</td>
<td>6-1000 (13.3-507)</td>
<td>115 (2.92)</td>
<td>140 (3.56)</td>
</tr>
<tr>
<td></td>
<td>Above 1000 (507)</td>
<td>175 (4.45)</td>
<td>175 (4.45)</td>
</tr>
<tr>
<td>15</td>
<td>2-1000 (33.6-507)</td>
<td>175 (4.45)</td>
<td>220 (5.59)</td>
</tr>
<tr>
<td></td>
<td>Above 1000 (507)</td>
<td>220 (5.59)</td>
<td>220 (5.59)</td>
</tr>
<tr>
<td>25</td>
<td>1-2000 (42.4-1013)</td>
<td>260 (6.60)</td>
<td>320 (8.13)</td>
</tr>
<tr>
<td>28</td>
<td>1-2000 (42.4-1013)</td>
<td>280 (7.11)</td>
<td>345 (8.76)</td>
</tr>
<tr>
<td>35</td>
<td>1/0-2000 (53.5-1013)</td>
<td>345 (8.76)</td>
<td>420 (10.7)</td>
</tr>
</tbody>
</table>


The DC field test voltages listed above are intended for cable designed in accordance with ICEA specifications. When older cables or other types/classes of cables or accessories are connected to the system, voltages lower than those shown may be necessary. Consult the manufacturers of the cables and/or accessories before applying the test voltage.
### TABLE 6 (CONT.)
Medium-Voltage Cables
Acceptance Test Values

<table>
<thead>
<tr>
<th>Rated Voltage Phase-to-Phase kV</th>
<th>Conductor Sizes AWG or kcmil (mm)</th>
<th>Nominal Insulation Thickness mils (mm)</th>
<th>100% Insulation Level</th>
<th>133% Insulation Level</th>
<th>AC Test Voltage, kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>100% Insulation Level</td>
<td>133% Insulation Level</td>
<td></td>
</tr>
<tr>
<td>5 kV</td>
<td>8-1000</td>
<td></td>
<td>90 (2.29)</td>
<td>115 (2.92)</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>1001-3000</td>
<td></td>
<td>140 (3.56)</td>
<td>140 (3.56)</td>
<td>23</td>
</tr>
<tr>
<td>8 kV</td>
<td>6-1000</td>
<td></td>
<td>115 (2.92)</td>
<td>140 (3.56)</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>1001-3000</td>
<td></td>
<td>175 (4.45)</td>
<td>175 (4.45)</td>
<td>35</td>
</tr>
<tr>
<td>15 kV</td>
<td>2-1000</td>
<td></td>
<td>175 (4.45)</td>
<td>220 (5.59)</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>1001-3000</td>
<td></td>
<td>220 (5.59)</td>
<td>220 (5.59)</td>
<td>44</td>
</tr>
<tr>
<td>25 kV</td>
<td>1-3000</td>
<td></td>
<td>260 (6.60)</td>
<td>320 (8.13)</td>
<td>52</td>
</tr>
<tr>
<td>28 kV</td>
<td>1-3000</td>
<td></td>
<td>280 (7.11)</td>
<td>345 (8.76)</td>
<td>56</td>
</tr>
<tr>
<td>35 kV</td>
<td>1/0-3000</td>
<td></td>
<td>345 (8.76)</td>
<td>420 (10.7)</td>
<td>69</td>
</tr>
</tbody>
</table>


All AC voltages are RMS values.
TABLE 6 (CONT.)
Medium-Voltage Cables
Acceptance Test Values

Table 6.3
Partial Discharge Requirements
for Semiconducting Coating and Tape Designs Only

<table>
<thead>
<tr>
<th>Rated Circuit Voltage Phase-to-Phase Volts</th>
<th>Minimum Partial Discharge Extinction Level, kV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100% Insulation Level</td>
</tr>
<tr>
<td>2001-5000</td>
<td>4</td>
</tr>
<tr>
<td>5001-8000</td>
<td>6</td>
</tr>
<tr>
<td>8001-15000</td>
<td>11</td>
</tr>
</tbody>
</table>


Table 6.4
Very Low Frequency Testing Levels
0.1 Hz Test Voltage (RMS)

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Phase-to-Phase (kV) (RMS)</th>
<th>Proof Phase-to-Ground (kV) (RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>47</td>
</tr>
</tbody>
</table>
### TABLE 12

**U.S. Standard**

**Bolt Torques for Bus Connections**

*Heat-Treated Steel – Cadmium or Zinc Plated*

<table>
<thead>
<tr>
<th>Grade</th>
<th>SAE 1 &amp; 2</th>
<th>SAE 5</th>
<th>SAE 7</th>
<th>SAE 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Tensile (psi)</td>
<td>64K</td>
<td>105K</td>
<td>133K</td>
<td>150K</td>
</tr>
<tr>
<td><strong>Bolt Diameter In Inches</strong></td>
<td>Torque (Foot Pounds)</td>
<td>Torque (Foot Pounds)</td>
<td>Torque (Foot Pounds)</td>
<td>Torque (Foot Pounds)</td>
</tr>
<tr>
<td>1/4</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>5/16</td>
<td>7</td>
<td>11</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>3/8</td>
<td>12</td>
<td>20</td>
<td>27</td>
<td>30</td>
</tr>
<tr>
<td>7/16</td>
<td>19</td>
<td>32</td>
<td>44</td>
<td>48</td>
</tr>
<tr>
<td>1/2</td>
<td>30</td>
<td>48</td>
<td>68</td>
<td>74</td>
</tr>
<tr>
<td>9/16</td>
<td>42</td>
<td>70</td>
<td>96</td>
<td>105</td>
</tr>
<tr>
<td>5/8</td>
<td>59</td>
<td>96</td>
<td>135</td>
<td>145</td>
</tr>
<tr>
<td>3/4</td>
<td>96</td>
<td>160</td>
<td>225</td>
<td>235</td>
</tr>
<tr>
<td>7/8</td>
<td>150</td>
<td>240</td>
<td>350</td>
<td>380</td>
</tr>
<tr>
<td>1.0</td>
<td>225</td>
<td>370</td>
<td>530</td>
<td>570</td>
</tr>
</tbody>
</table>

**Bolt Torques for Bus Connections**

*Silicon Bronze Fasteners*¹

*Torque (Foot Pounds)*

<table>
<thead>
<tr>
<th>Bolt Diameter in (Inches)</th>
<th>Nonlubricated</th>
<th>Lubricated</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>3/8</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>1/2</td>
<td>40</td>
<td>25</td>
</tr>
<tr>
<td>5/8</td>
<td>55</td>
<td>40</td>
</tr>
<tr>
<td>3/4</td>
<td>70</td>
<td>60</td>
</tr>
</tbody>
</table>

¹ Bronze alloy bolts shall have a minimum tensile strength of 70,000 psi
### TABLE 12 (CONT.)

**Bolt Torques for Bus Connections**

**Aluminum Alloy Fasteners**

<table>
<thead>
<tr>
<th>Bolt Diameter in Inches</th>
<th>Torque (Foot Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>8.0</td>
</tr>
<tr>
<td>3/8</td>
<td>11.2</td>
</tr>
<tr>
<td>1/2</td>
<td>20.0</td>
</tr>
<tr>
<td>5/8</td>
<td>32.0</td>
</tr>
<tr>
<td>3/4</td>
<td>48.0</td>
</tr>
</tbody>
</table>

2 Aluminum alloy bolts shall have a minimum tensile strength of 55,000 psi.

**Bolt Torques for Bus Connections**

**Stainless Steel Fasteners**

<table>
<thead>
<tr>
<th>Bolt Diameter in Inches</th>
<th>Torque (Foot Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>14</td>
</tr>
<tr>
<td>3/8</td>
<td>25</td>
</tr>
<tr>
<td>1/2</td>
<td>45</td>
</tr>
<tr>
<td>5/8</td>
<td>60</td>
</tr>
<tr>
<td>3/4</td>
<td>90</td>
</tr>
</tbody>
</table>

3 Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy.
Belleville washers: 302 alloy.
### TABLE 14

Insulation Resistance Conversion Factors For
Conversion of Test Temperature to 20°C

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Temperature °F</th>
<th>Apparatus Containing Immersed Oil Insulations</th>
<th>Apparatus Containing Solid Insulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>32</td>
<td>0.25</td>
<td>0.40</td>
</tr>
<tr>
<td>5</td>
<td>41</td>
<td>0.36</td>
<td>0.45</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>15</td>
<td>59</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>20</td>
<td>68</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>25</td>
<td>77</td>
<td>1.40</td>
<td>1.25</td>
</tr>
<tr>
<td>30</td>
<td>86</td>
<td>1.98</td>
<td>1.58</td>
</tr>
<tr>
<td>35</td>
<td>95</td>
<td>2.80</td>
<td>2.00</td>
</tr>
<tr>
<td>40</td>
<td>104</td>
<td>3.95</td>
<td>2.50</td>
</tr>
<tr>
<td>45</td>
<td>113</td>
<td>5.60</td>
<td>3.15</td>
</tr>
<tr>
<td>50</td>
<td>122</td>
<td>7.85</td>
<td>3.98</td>
</tr>
<tr>
<td>55</td>
<td>131</td>
<td>11.20</td>
<td>5.00</td>
</tr>
<tr>
<td>60</td>
<td>140</td>
<td>15.85</td>
<td>6.30</td>
</tr>
<tr>
<td>65</td>
<td>149</td>
<td>22.40</td>
<td>7.90</td>
</tr>
<tr>
<td>70</td>
<td>158</td>
<td>31.75</td>
<td>10.00</td>
</tr>
<tr>
<td>75</td>
<td>167</td>
<td>44.70</td>
<td>12.60</td>
</tr>
<tr>
<td>80</td>
<td>176</td>
<td>63.50</td>
<td>15.80</td>
</tr>
</tbody>
</table>
TABLE 18
Thermographic Survey
Suggested Actions Based on Temperature Rise

<table>
<thead>
<tr>
<th>Temperature difference (TD) based on comparisons between similar components under similar loading</th>
<th>Temperature difference (TD) based upon comparisons between component and ambient air temperatures</th>
<th>Recommended action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1°C to 3°C</td>
<td>1°C to 10°C</td>
<td>Possible deficiency; warrants investigation</td>
</tr>
<tr>
<td>4°C to 15°C</td>
<td>11°C to 20°C</td>
<td>Indicates probably deficiency; repair as time permits</td>
</tr>
<tr>
<td>-- -- --</td>
<td>21°C to 40°C</td>
<td>Monitor until corrective measures can be accomplished</td>
</tr>
<tr>
<td>&gt;15°C</td>
<td>&gt;40°C</td>
<td>Major discrepancy; repair immediately</td>
</tr>
</tbody>
</table>

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on $\Delta T$. In the absence of consensus standards for TD, the values in this table will provide reasonable guidelines.


It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology.
SECTION 26 09 23 – LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Control system shall provide zonal occupancy control to a multitude of luminaires.
B. Luminaire occupancy and non-occupancy light level schedules shall be configurable via a graphical user interface (GUI) through an internet browser.
C. System and network configurability shall be allowed through a graphical user interface (GUI) accessible via an internet browser.
D. GUI shall provide an interactive 3-D layout of the parking deck or lot.
E. Light level schedules shall be configurable and based on a 24-hour schedule, user-defined time schedule, or based on sunrise/sunset times.
F. The control system shall provide an internet access point.
G. System program configurations shall be embedded locally on each device.
H. Parking Garage Luminaires:
   1. As listed in Light Fixture Schedule

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Interconnection diagrams showing field-installed wiring.
   2. Include diagrams for power, signal, and control wiring.
   3. Schedules
   4. Layout with Zones

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.
PART 2 - PRODUCTS

2.1 LIGHTING CONTROLLER

A. Manufacturer: others by prior approval from the owner and engineers.

1. Kenall Teklink TL1000 wired control system.
   a. The lighting controller shall support firmware updates through the network interface.
   b. The lighting controller shall support the following configurable zone schedule parameters:
      1) Normal Timeout, Minimum 30 seconds.
      2) Day Timeout, Minimum 30 seconds.
      3) Night Timeout, Minimum 30 seconds.
      4) Normal Occupancy Light Levels, Minimum 0%, Maximum 100%.
      5) Day Occupancy Light Levels, Minimum 0%, Maximum 100%.
      6) Night Occupancy Light Levels, Minimum 0%, Maximum 100%.
      7) Normal Non-Occupancy Light Levels, Minimum 0%, Maximum 100%.
      8) Day Non-Occupancy Light Levels, Minimum 0%, Maximum 100%.
      9) Night Non-Occupancy Light Levels, Minimum 0%, Maximum 100%.
      10) Day Time (Seconds)
   c. The lighting controller shall allow setting and updating the zone schedule parameters over the network communication link.
   d. Lighting controller data samples shall include the following information:
      1) Timestamp, determined by Atomic Clock.
      2) Energy (kW/hr), Precision 0.1 kW/hr.
      3) Power (W), Precision 1 W.
      4) Voltage (V), Precision 1 V.
      5) Current (A), Precision 0.01 A.
      6) Power Factor, Precision 0.01
      7) Light Level (fc), Precision 0.1 fc.
      8) Luminaire Ambient Temperature (°C), Minimum -30 °C, Maximum +85 °C, Precision 0.1 °C.
      9) LED Power Supply Temperature (°C), Minimum -30 °C, Maximum +85 °C, Precision 0.1 °C.
      10) Occupancy Events, Precision 1.
   e. Lighting controller shall be uniquely identified by MAC address.
   f. Lighting controller shall be capable of communicating with up to three lighting zones.
   g. Lighting controller shall provide a Bluetooth Low Energy method to identify itself during commissioning
   h. Lighting controller shall store accumulated power in non-volatile memory.

2.2 NETWORK CONTROLLERS

A. Manufacturer: others by prior approval from the owner and engineers.

1. Kenall Teklink TL1000 wired control system.
a. The network controllers shall support firmware updates for their host processor by means of firmware download from a cloud web service.
b. The network controllers shall obtain the current time from a cloud web service.
c. The network controllers shall upload lighting controller event data to the cloud.
d. Communication between the system and the cloud web services shall use SSL/TLS security.
e. Network controllers shall use a self-signed certificate for access to its web services.
f. Network controllers shall use a self-signed certificate for access to its web services.
g. Network controllers shall support up to 10 lighting controller zones.
h. Network controllers shall support up to 10 lighting controller zones.

2.3 OCCUPANCY AND LIGHT LEVEL SENSORS

A. Manufacturer: others by prior approval from the owner and engineers.

1. Kenall Teklink TL1000 wired control system.

a. Sensor shall operate by low-voltage power provided by the integrated lighting control system.
b. Sensor shall use passive infrared (PIR) technology for occupancy detection with integral photocell for light level sensing.
c. Sensor lens options shall provide 360° coverage at various mounting heights.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Occupancy/light level sensors shall be, at minimum, installed at designated pedestrian and vehicular paths of ingress/egress.

B. Enclosures for all control system components shall have a minimum rating of IP65 and Wet Location.

C. Control system shall be listed to UL 508 by a Nationally Recognized Testing Laboratory (NRTL).

D. Components shall be suitable for operating in temperatures of -40°C to 40°C.
E. Communication wires (18 or 20 AWG) between the Lighting and Network Controllers shall be allowed in the same conduit as branch power if the following conditions are met:

1. Communication wire insulation rating is equal to or above branch power voltage level.
2. Communication wires are Shielded Twisted Pair.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting panels.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches, contactors, bridges and gateways with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing control system, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 COMMISSIONING

A. The manufacturer shall be on site to commission and program the system to owner’s desired conditions prior to substantial completion.
3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.7 DEMONSTRATION AND TRAINING

A. Coordinate demonstration and training of products specified in this Section with owner for an appropriate date and time for owner personnel to learn the system at substantial completion.

1. Date and Time shall be planned with owner and the owner given 4 week notice of acceptable times.

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

1. Manufacturer shall plan two days with, (2) 2 hours sessions / day, for training owner’s personnel.
2. All Training to be documented with a video camera and provided to the owner on DVD (4 copies).

END OF SECTION 26 09 23
SECTION 26 12 19 – PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED WORK
   A. Section 26 0812 - Power Distribution Acceptance Tests
   B. Section 26 0813 - Power Distribution Acceptance Test Tables

1.2 DESCRIPTION OF SYSTEM
   A. Specification covers 3-phase, liquid-filled, compartmental type, loop feed, pad-mounted transformers, including tap changers, fuses, and terminations.

1.3 REFERENCE STANDARDS
   A. ANSI C57.12.26 Standard for Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, 3-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, H-V, 34,500 Grd/19,920 V and below; 2500 kVA and Smaller.
   B. ANSI C57.12.28 Pad-Mounted Equipment - Enclosure Integrity.
   C. IEEE C57.12.00 Standard General; Requirements for Liquid - Immersed Distribution, Power, and Regulating Transformers.
   D. UL 340 Tests for Comparative Flammability of Liquids.

1.4 SUBMITTALS
   A. Submit shop drawings for equipment provided under this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Acceptable Manufacturers: ABB, Cooper, General Electric, RTE, Square D
   B. Rating of transformer(s) shall be as shown on drawings:
      1. kVA as shown on plans
      2. Primary Voltage 12470Y/7200 Wye
      3. BIL 95 kV
      4. Secondary Voltage 480Y/277 Wye
      5. Impedance 5.75
      6. Temperature Rise 65°C (over 30°C average ambient temperature)
2.2 CONSTRUCTION

A. Transformer(s) shall:
   1. Be compartmental type, self-cooled, tamper-resistant and weatherproof.
   2. Include sealed tank construction to withstand pressure of 15 psi.
   3. Include welded cover.

B. Transformer tank and high and low voltage compartments shall be assembled as integral unit.

C. High and low voltage compartments shall be located side by side, separated by a steel barrier.

D. Cooling panels will be provided on back of tank.

E. High voltage compartment shall not be accessible until low voltage door has been opened.

F. Low voltage door shall have 3-point latching mechanism with vault type handle having provisions for single padlock and pentahead locking device.

G. Access doors shall have provisions for securing doors in open position.

H. Provide lifting eyes and jacking pads.

I. Include tank grounding provisions in each compartment.

J. Provide a minimum of (2) welded, ground lug attachment points for concentric neutral termination on lower front of transformer tank. Ground lugs shall accommodate 1/0 stranded copper ground conductor.

2.3 FINISH

A. In accordance with ANSI C57.12.28 – Standard for Pad-mounted Enclosure Integrity.

B. Dark green per ANSI standards.

2.4 INSULATING FLUID

A. Coolant and insulating fluid shall be less flammable, dielectric, with fire point of not less than 300°C Liquid shall be biodegradable and nontoxic, Envirotemp FR3 or Biotemp.

2.5 CORE AND COIL CONSTRUCTION

A. Coils shall be wound with copper windings.

B. Core shall be high grade, grain oriented silicon steel laminations.

C. Core and coil assemblies shall be wound core type, 5-legged construction.

D. Internal leads shall be insulated.

E. Manual Tap Changer:
   1. Provide tap changer, externally operated.
2. Tap changer handle shall have provisions for padlocking.
3. Tap changer shall be 4-position with four 2-1/2% full capacity taps, 2 above and 2 below rated voltage.

2.6 HIGH VOLTAGE COMPARTMENT

A. Terminations:
1. Terminations shall be dead front construction.
2. Provide universal 200 amp load break type bushing wells and parking stands as indicated on drawings, for loop feed and mounting accessory equipment.
3. Bushing wells shall be externally clamped and externally removable.
4. Provide 1 set of load break bushings and 1 load break feed-thru insert for each phase.
5. Mount lightning arrestors to one side and phase conductor elbows to other side.

B. High Voltage Switch:
1. Provide integral, oil immersed, 4-position, rotary, gang operated, rated for load break operation, T-Blade design with make before break option.
2. Switches shall rotate full 360 degrees without a physical stop. Moveable index plate shall be provided that will limit accidental switch rotation.
3. Switch operating handles shall be permanently attached, hook stick operable, and clearly marked for switch operation and circuit identification.
4. One-line electrical diagrams of switch arrangements shall be mounted in clear view when transformer access doors are opened. Phase identification shall be clearly marked.
5. Primary switches shall be rated 200 amp (min.) continuous current.
6. The switch positions and required sequences are defined below. Position 1 at 12:00 and rotation listed is clockwise.

Position Description
1. Source A and B connected to transformer winding
2. Source B connected to transformer winding
3. Source A connected to B, transformer winding disconnected
4. Source A connected to transformer winding

Note: Load break bayonet fuse devices shall not be considered as providing a switching function.

C. Primary Fusing:
1. Provide Bay-O-Net type fuse combined with current limiting backup fuses.
2. Fuses shall have continuous current ratings sized per manufacturer’s recommendations for indicated kVA, impedance, and primary voltage.
3. Primary fuse assembly shall have minimum rating of 6000 amps.
4. Bayonet fuse units shall be oil immersed, hot stick operable, and rated for load break operation.
5. Provide Load sensing fuse elements.
6. Provide (1) spare fuse element for each bayonet fuse.
7. Provide oil drip tray for each bayonet fuse.

D. Surge Arrestors:
1. Provide 3 distribution class metal oxide varistor type surge arrestors, installed in high voltage compartment and grounded to structure. Connect to incoming load break bushings.
2.7 LOW VOLTAGE TERMINATIONS AND EQUIPMENT

A. Bushings shall be molded epoxy.

B. Externally clamped, blade type spade terminals with 6 hole NEMA spacing.

C. High voltage neutral on Wye-Wye units shall be connected internally to low voltage neutral with provisions for opening this connection for testing.

D. Low voltage neutral bushing shall be fully insulated.
   1. Connect to adjacent ground pad on tank with detachable strap.

E. Accessories:
   1. Each transformer shall be equipped with the following:
      a. Dial type thermometer for indicating top liquid temperature.
      b. Globe valve to serve as drain valve, bottom filler plug connection, and liquid sampling valve.
      c. Globe valve for top filter plug connection and vacuum pump connection.
      d. Pressure vacuum gauge.
      e. Magnetic liquid-level indicator.
      f. Spare fuse pocket with 1 complete set of fuses.
   2. Pressure relief device.
   3. Stainless steel nameplate mounted in low-voltage compartment with the following information:
      a. Serial number and style number.
      b. Graphic representation of high-voltage and low-voltage connections.
      c. kVA ratings at all cooling class ratings and temperature rises.
      d. Transformer impedance at 55°C base kVA rating.
      e. Tap changer positions, voltages and full load currents at each tap setting.
      f. Low voltage rating and full load current.
      g. Gallons of liquid in tank and radiators.
      h. Maximum allowable pressure on tank.
      i. Transformer weight with and without oil.
      j. Listing as non-PCB transformer.

F. Labeling:
   1. Provide 7” x10” warning label on outside high voltage compartment door and danger label on inside low voltage compartment door.

2.8 HARDWARE

A. Provide hardware, including bolts, fasteners, caps, plugs, etc. of corrosion resistant materials or plated with corrosion resistant materials.

2.9 TESTING

A. Report of transformer tests shall be submitted for each transformer:
   1. Standard ANSI tests.
   2. Resistance measurements of windings on rated voltage tap of each transformer and at tap extremes of 1 transformer only of given rating on order.
   3. Ratio tests on rated voltage connections and on tap connections.
4. Phase-relation and polarity tests on rated voltage connections.
5. No load losses and excitation current at rated voltage on rated voltage connections.
6. Impedance and load losses at rated current on rated voltage connections of each transformer and on extremes of 1 unit only of given rating on order.
7. Applied and induced potential tests.
8. Regulation and efficiency at rated load and voltage.
9. Insulation resistance tests (high voltage to ground, low voltage to ground, high voltage to low voltage).

B. Temperature test or tests shall be made on 1 unit only of transformers covered by these specifications of given rating, provided that test data is not available from records of temperature tests on duplicate or essentially duplicate transformer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install components as indicated and in accordance with manufacturer's instructions and recommendations.

B. Install transformer level and plumb.

C. Provide means for lifting complete transformer.

D. Bearing surfaces of lifting means shall be free from sharp edges.

E. Provide facilities for guying transformer.

F. Provide lifting means for untanking transformer.

G. Base shall permit rolling (or sliding) in directions of both center lines of transformer and provision shall be made for pulling transformer in these directions.

H. Locate jacking facilities near extreme ends of junction of base segments.

I. Jack ports or lugs shall be so designed that lifting members of jack can be inserted.

J. If liquid filling of any part of transformer is required at job site, supplier shall furnish liquid and job site supervision, and shall furnish or make available suitable filter press and vacuum pump.
3.2 ACCEPTANCE TESTING

   A. Testing by Testing Agency

   B. Acceptance testing to be performed in accordance with Section 26 0812 – Power Distribution Acceptance Tests and Section 26 0813 – Power Distribution Acceptance Test Tables.

END OF SECTION 26 12 19
SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

   1. Distribution transformers.

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Indicate dimensions and weights.


C. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. ACME Electric Corporation; Power Distribution Products Division.
   2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
   5. Siemens Energy & Automation, Inc.
2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
   1. Internal Coil Connections: Brazed or pressure type.
   2. Coil Material: Copper.

D. All transformers larger than 112.5 kva shall have an insulation system equal or greater than class 155 and shall be completely enclosed except for ventilation openings.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.
   1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.
   2. Provide weathershield for NEMA 3R rating for all transformers located outdoors.

E. Transformer Enclosure Finish: Comply with NEMA 250.
   1. Finish Color: Manufacturer’s Standard.

F. Taps for Transformers Smaller Than 3 kVA: None.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Minimum of two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:
   1. Complying with NEMA TP 1, Class 1 efficiency levels.
   2. Tested according to NEMA TP 2.
K. Electrostatic Shielding: Transformers indicated to be shielded shall have each winding shielded with an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate. Nameplates are specified in Division 26 Section "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3.3 ADJUSTING

A. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.


END OF SECTION 26 22 00
SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.
1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets as indicated on panel schedules.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

   a. All circuit directories shall be typed. Hand written circuit directories are not acceptable.

C. Incoming Mains Location: Determined by Contractor unless otherwise noted on plans.

D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

2. Main and Neutral Lugs: Compression or Mechanical type.
3. Ground Lugs and Bus Configured Terminators: Compression or Mechanical type.
4. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression or Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by a NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.

2.2 DISTRIBUTION & SERVICE ENTRANCE PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Doors shall be Door in Door Style cover. Provide two keys for every panelboard provided. All keys keyed alike.

D. Mains: Circuit breaker or lugs only as indicated on panel schedules.


G. Fused switches are not permitted in panelboards unless specifically noted on contract documents.

H. All main service panelboards shall be rated for use as a service-entrance.

I. On all main service entrance panelboards, and on other panelboards specified on the plans, provide integral surge protective devices (SPD) with 100 kA surge current rating at 240 VAC or 480 VAC. SPD shall be internal to the panel connecting directly to the bus. Device shall be equal to Square-D SurgeLogic.

J. Provide GFI protection for the main service circuit breaker for all 277/480 volt services of 1000 amperes or more in accordance with NEC 230-95.

K. Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by a NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated on panel schedules.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units. Plug-in style breakers are not permitted.

E. Doors: Door in Door style cover; secured with flush latch with tumbler lock; keyed alike. Provide two keys for every panelboard provided. All keys keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents. Provide thermal-magnetic breakers unless otherwise indicated on contract documents.

3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I²t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5. Provide only when indicated on panel schedule.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip). Provide only when indicated on panel schedule.
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration. Provide only when indicated on panel schedule.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories, provide where indicated on plans:
   a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrially mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Communication Capability: Circuit-breaker-mounted or Integral-mounted communication module with functions and features compatible with power monitoring and control system if specified in Division 26 Section "Electrical Power Monitoring and Control."

f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at \[55\] \[75\] percent of rated voltage.

g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 72 inches above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. At all flush-mounted panelboards in finished spaces, stub spare \(\frac{3}{4}\)-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

H. Comply with NECA 1.
3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NECA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 24 16
SECTION 26 27 13 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section includes equipment for electricity metering.
   B. All metering equipment must be compatible with the Owner's existing Square D ION metering system by Schneider Electric and the existing software associated with that system.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Dimensioned plans and sections or elevation layouts and wiring diagrams.

1.3 INFORMATIONAL SUBMITTALS
   A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS
   A. Operation and Maintenance Data:
      1. Product data.
      2. Operating instructions.

1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER
   A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings, as manufactured by:
      1. Square D; a brand of Schneider Electric.
   B. General Requirements for Owner’s Meters:
1. Comply with UL 1244.
2. Provide meters and accessory equipment as indicated on drawings.
3. Current-Transformers: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
4. Compatible with dry contact pulse count for flow meters and other mechanical meters.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Comply with equipment installation requirements in NECA 1.
   B. Install meters in accordance with manufacturer’s recommendations and instructions.
   C. Provide connections as shown on drawings.
   D. Provide all programming and site licenses as required for a complete system in accordance with MSU standards.

3.2 IDENTIFICATION
   A. Comply with requirements for identification specified in Section 26 05 53 “Identification for Electrical Systems.”

3.3 SYSTEM START-UP
   A. Start-up services.
      1. Manufacturer’s Field Service: Engage a factory-authorized service representative to configure system and bring system into operation.
      2. Service representative shall assist the Owner in interfacing new metering equipment with their existing system and the new building management system. Provide at least one day at the Owner’s selected location for this part of the service.

3.4 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
      1. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
   B. Tests and Inspections:
      1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
      2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 26 27 13
SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED
   A. Wall Switches.
   B. Receptacles.
   C. Device Plates and Box Covers.
   D. Occupancy Sensors

1.2 RELATED WORK
   A. Low-Voltage Electrical Power Conductors & Cables 260519
   B. Raceway & Boxes for Electrical Systems 260533
   C. Interior Lighting 265100

1.3 REQUIREMENTS OF REGULATORY AGENCIES
   A. All devices shall be UL listed.

1.4 SHOP DRAWING SUBMITTALS
   A. Submit product data as required.
   B. Provide product data showing configurations, finishes, dimensions, and manufacturers instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
   A. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   B. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   D. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
   E. General Electric
F. Sensor Switch

2.2 COLORS
A. All device colors shall be Gray.

2.3 WALL SWITCHES
A. In all spaces:
   1. Specification Grade AC Toggle Switch, 20 amperes, 120-277 volt, clamp type, screw terminal, side or back wired:
      a. Single Pole, 20 ampere                      Hubbell CS1221I
      b. Double Pole, 20 ampere                    Hubbell CS1222I
      c. Three-way, 20 ampere                      Hubbell CS1223I
      d. Four-way, 20 ampere                      Hubbell CS1224I
   B. Where shown on plans:
      1. Pilot Light Switch, 20 ampere, light on with load on:
         a. SPST, 20 ampere, 120V, w/ pilot light    Hubbell HBL1221 PL
      2. Fused Switches:
         a. Box cover units with switch and plug fuse holder Bussman SSU, SSW, SSY
            Provide fuse sized for load
      3. Keyed Switches:
         a. Lock-Type, chrome lock dome              Leviton 1221-2KL
            Provide FOUR keys to Owner

2.4 RECEPTACLES
A. In all spaces:
   1. Style Line, Specification Grade, 20 ampere, 120 volt, clamp type, screw terminal, side or back wired.
      a. Duplex, 20 ampere, 125V (NEMA 5-20R)       Hubbell HBL 2162 Series
      b. Duplex, ground fault interrupter, 20 ampere, (NEMA 5-20R)    Hubbell GF 5352 Series
      c. Isolated Ground Receptacle, 20 ampere, (NEMA 5-20R)    Hubbell No IG5362 Series

REFER TO THE DRAWINGS FOR OTHER OUTLETS REQUIRED FOR THIS PROJECT.

2.5 DEVICE PLATES AND BOX COVERS
A. In all rooms and spaces:
   1. Stainless Steel Covers
2. Recept Plate, weatherproof “while in-use” Steel Cover

B. Device plates for thirty ampere and larger outlets shall be No. 302 /No. 430 stainless steel and suitable for the wiring device used.

2.6 OCCUPANCY SENSORS

1. As scheduled in the Electrical Legend on the Contract Drawings

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Furnish and install wiring devices as shown on the contract drawings and as specified herein.

B. Install wiring devices plumb with walls so that device plates are tight to finish surfaces.

C. Wiring devices shall be minimum 20 ampere in all areas, unless noted otherwise herein or on the contract drawings.

D. GFCI receptacles shall not be utilized for feed thru function to protect downstream devices. Each GFCI device as shown on plan shall dedicated to server location where shown only.

3.2 DEVICE HEIGHTS AND LOCATIONS

A. Mount wiring devices at heights above finished floor as noted below or as shown on the contract drawings:

1. Convenience Receptacles 15 inches to center
2. Switches/Dimmers 48 inches to center
3. Telephone/Data/TV 15 inches to center
4. Telephone (wall-mounted) 48 inches to center
5. Fire Alarm Notification Appliances Top of appliance 6” below ceiling or 80” to strobe light, whichever is lower
6. Fire Alarm Pull Stations 48 inches to center
7. Thermostats 54 inches to center

B. Coordinate all device locations with architectural elevations and other plans before rough-in. Adjust device locations to accommodate casework elevations or knee-space locations or any other architectural or other trade obstruction. Contact the architect or engineer if any conflicts are present that cannot be resolved without substantially changing the layout of devices. The contractor shall be responsible to relocate any devices that are improperly coordinated.

C. Wherever receptacles are shown adjacent to tel/data, video or other low voltage locations, even if on separate plans, install boxes side-by-side with a consistent distance separating the boxes of no more than 3” between adjacent faceplates. Provide or coordinate additional framing as required.

END OF SECTION 26 27 26
SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes: Fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor-control centers.

1.2 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Operation and maintenance data.

1.3 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with NEMA FU 1 for cartridge fuses.
C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Mersen, Inc.
4. Littelfuse, Inc.

2.2 FUSES
A. Characteristics: NEMA FU 1, nonrenewable fuses with voltage ratings consistent with circuit voltages.
PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

A. Service Entrance: Class RK1, time delay; or Class J, time delay.

B. Feeders: Class RK1, time delay; Class RK5, time delay; or Class J, time delay.

C. Motor Branch Circuits: Class RK5, time delay.

D. Other Branch Circuits: Class RK1, time delay; Class RK5, time delay; or Class J, fast acting.

E. Control Circuits: Class CC, fast acting.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Provide a spare fuse cabinet equal to Bussman SFC-FUSE-CAB (30” x 24” x 12”). Mount near main distribution panel or where majority of fused devices are located. Provide three spare fuses of each fuse type and size used in project.

3.3 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block and holder.

END OF SECTION 26 28 13
SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Non-fusible switches.
   3. Shunt trip switches.
   4. Stand-alone molded-case circuit breakers (MCCBs).
   5. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

   1. Wiring Diagrams: For power, signal, and control wiring.
C. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
D. Field quality-control reports.
E. Operation and maintenance data.
1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.
5. Hubbell

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac (as required to accommodate actual voltage), 1200 A and smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NON-FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac to accommodate specified voltage, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

2.3 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt-trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight ON pilot light.
3. Isolated neutral lug.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; confirm coil voltage with fire alarm contractor.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
8. Provide auxiliary switch on or interlocked with lockable handle. Switch to change state if handle is switched.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and $I^2t$ response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

F. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Following items if specified on plans:
      a. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
      b. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
      c. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
      d. Alarm Switch: One N.O. contact that operates only when circuit breaker has tripped.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 28 16
SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Interior lighting fixtures, lamps, and ballasts.
   2. Emergency lighting units.
   3. Solid State lighting and drivers
   4. Exit signs.
   5. Lighting fixture supports.

1.2 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.

D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers specified on Light Fixture Schedule.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
B. Metal Parts:  Free of burrs and sharp corners and edges.

C. Sheet Metal Components:  Steel, unless otherwise indicated.  Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access:  Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools.  Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Plastic Diffusers, Covers, and Globes:
   1. Acrylic Lighting Diffusers:  100 percent virgin acrylic plastic.  High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness:  At least 0.125 inch minimum unless different thickness is specified.
      b. UV stabilized.
   2. Glass:  Annealed crystal glass, unless otherwise indicated.

2.3 SOLID STATE LIGHTING AND DRIVERS

A. Low-Temperature Capability:  Rated by its manufacturer for reliable starting and operation of indicated components at temperatures at Minus 25 deg F.

B. Lumininaire Characteristics:
   1. Lumen Maintenance percentage at 60000 hours equal to 90% or higher.
   2. IP Rating of IP66 or greater
   3. LED Thermal Management.
   4. Calculated L70 hours of 130000 or higher.
   5. 0-10 volt dimming capable
   6. Serviceable high power factor electronic, constant current driver <20%THD, .95 PF
   7. Replaceable boards and drivers

C. Warranty of 5 years or Greater.

2.4 EXIT SIGNS

1. Internally Lighted Signs:  Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

2.5 EMERGENCY LIGHTING UNITS

A. Description:  Self-contained units complying with UL 924.
   1. Battery:  Sealed, maintenance-free, lead-acid type.
   2. Charger:  Fully automatic, solid-state type with sealed transfer relay.
   3. Operation:  Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below.  Lamp automatically disconnects from battery when voltage...
approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 SPARE PARTS

A. Provide Drivers and Boards as specified on Light Fixture Schedule

B. Furnish spare boards identical to those installed in each fixture. Quantity: 10% of total boards used or a minimum of three (3) lamps of each type, whichever is greater.

C. Furnish spare drivers identical to those used in each fixture. Quantity: 2 ballast or 3% of each fixture type, whichever is greater.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing or equal or better by manufacturer with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes or equal or better by manufacturer with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge or equal or better by manufacturer.

E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Comply with NFPA 70 for minimum fixture supports.

C. Suspended LightingFixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to satisfaction of owner.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

F. Organize and execute a 100-hour, uninterrupted burn-in period for all fluorescent luminaries. Luminaires shall be installed in final location prior to burn-in.

G. Re-lamp all luminaries used for construction purposes at completion of project for final acceptance.

H. Align luminaries and clean lenses and diffusers at completion of Project. Clean paint splatters, dirt and debris from installed luminaries. Replace any dented, scratched, soiled or cracked lens or other fixture parts.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 26 51 00
SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Solid State Lighting (LED) and drivers
4. Poles and accessories.

B. See Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.2 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.

B. Shop Drawings: Include anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: As indicated on Light Fixture Schedule or as approved through prior approval process.

2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.


N. Factory-Applied Finish for Aluminum Luminaires: Color shall be as specified on Light Fixture Schedule or selected by Architect, if so specified. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
1. Relay with locking-type receptacle shall comply with NEMA C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 SOLID STATE LIGHTING AND DRIVERS

A. Low-Temperature Capability: Rated by its manufacturer for reliable starting and operation of indicated components at temperatures at Minus 25 deg F.

B. Luminaire Characteristics:
   1. Lumen Maintenance percentage at 60000 hours equal to 90% or higher.
   2. IP Rating of IP66 or greater
   3. LED Thermal Management.
   4. Calculated L70 hours of 130000 or higher.

C. Warranty of 5 years or Greater.

2.5 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.
   1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
   2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
   1. Materials: Shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
   3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

E. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.6 CONCRETE POLES

A. Poles: As specified on Contract Drawings.
B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
   1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
   2. Finish: Same as luminaire.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.
   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming to satisfaction of Owner.

3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:
   1. Fire Hydrants: 8’.
   3. Trees: 15’.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
   1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
   2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
   3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch diameter PVC pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

F. All poles shall be checked after one (1) year of operation for proper vertical alignment and shall be adjusted to true plumb if necessary.

3.3 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location, unless otherwise specified on plans. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

END OF SECTION 26 56 00
SECTION 27 00 00 – COMMUNICATIONS PROJECT OVERVIEW

PART 1 - GENERAL

1.1 PROJECT REVIEW

A. This project includes voice and data cabling at Montana State University located in Bozeman, Montana.

1.2 SUMMARY OF WORK

A. This project includes the installation, testing and certification of telephone and data networking components at Montana State University. Network media included in this project are horizontal Category 6 data and voice cabling, backbone multi-pair copper cable, and backbone singlemode fiber optic cable. The drawings listed below provide further details of the installation.

1.3 RELATED PROJECTS

A. The Contractor for this project will be required to coordinate with other contractors providing data, telephone, audio and video equipment and installation directly to the Owner.

1.4 DIVISION 27 OVERVIEW

A. Section 27 01 00 Basic Telecommunications Requirements
B. Section 27 11 00 Telecommunications Rooms
C. Section 27 12 00 Pathways, Fittings and Boxes
D. Section 27 15 00 Backbone Cabling Requirements
E. Section 27 16 00 Horizontal Cabling Requirements

1.5 DRAWING OVERVIEW

A. Associated with this Division 27 specification is a series of drawings to indicate outlet locations and types of services delivered.

<table>
<thead>
<tr>
<th>Sheet</th>
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<tbody>
<tr>
<td>T1.00</td>
<td>Overall Telecomm. Site Plan</td>
</tr>
<tr>
<td>T1.01</td>
<td>Ground Level – Telecomm. Plan</td>
</tr>
</tbody>
</table>
1.6 CONTRACTOR QUALIFICATIONS

A. Division 27 Sub-contractor shall be a certified TE Connectivity Network Design & Installation (ND&I) Contractor and will be required to provide a TE 25-year performance warranty on parts and labor for the copper cabling system. Proof of the Sub-Contractor’s ability to provide such a warranty shall submitted to the General Contractor at the time of bidding and to the Owner prior to the Notice To Proceed. This warranty shall cover the patch panels, horizontal cabling, work area outlets, and equipment and cords.

B. Contractor shall employ, in conjunction with construction of the project, a capable, experienced, and reliable foreperson and such skilled workers as may be required for the various classes of work to be performed. Contractor shall be required to submit evidence of foreperson’s skilled experience on EIA/TIA certified fiber optic systems. Evidence of experience shall be submitted to Owner with submittal of bid. Minimum experience for any workman involved in cabling work shall be.

1. Cable pulling and termination work on projects for a minimum of 5 years. Provide references throughout this period.

2. Completion of training (40 hrs. minimum) which certifies the person’s work in fiber optic installations.

3. If, in the opinion of the Owner’s representative, the Contractor’s employees do not possess the necessary qualifications to install cabling and terminations, the Contractor will be required to obtain the services of workers who are certified and trained by an appropriate schooling organization. These workers, if required, shall be provided at no additional expense to the Owner.
SECTION 27 01 00 - BASIC TELECOMMUNICATIONS REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Include in bid all labor, materials, tools, transportation, storage costs, training, equipment, insurance, temporary protection, permits, inspections, taxes and all necessary and related items required to provide complete and deliver operational systems shown and described.

B. References to Codes and Standards called for in the Contract Documents mean the latest edition, amendment and revisions to the Codes and Standards in effect on the date of these Contract Documents.

1. Minimum composition requirements and/or installation methods for the following materials and work are included in this Section:
   a) Miscellaneous supports
   b) Access doors and panels
   c) Fire stopping
   d) Flashing and sealing
   e) Cutting and patching
   f) Waterproofing

C. Contract shall include, but not be limited to:
   1. Copper and fiber optic cabling
   2. Routing cabling through new telecommunication pathways
   3. Telecommunication spaces

1.2 RELATED SECTION AND DOCUMENTS

A. All drawings and general provisions of Contract and Instructions to Bidders apply to this section and all other sections of Division 27.

1.3 REGULATIONS AND CODE COMPLIANCE

A. All work and materials shall conform to and be installed, inspected and tested in accordance with the governing rules and regulations of federal, state and local governmental agencies.

B. The following is a list of codes and standards that will apply to this project:
   1. Federal Occupational Safety and Health Administration - OSHA
   4. Underwriters Laboratory (UL)
   5. Owner’s Insurance Carrier
   6. ANSI/TIA/EIA - Building Telecommunications Standards
   7. BICSI Telecommunications Distribution Methods Manual
   8. IEEE Standards
   9. Federal Communications Commission

BASIC TELECOMMUNICATIONS REQUIREMENTS 27 01 00-1
10. NEMA – National Electrical Manufacturers’ Association

11. ADA, Americans with Disabilities Act


1.4 GLOSSARY

A. ANSI American National Standards Institute
B. ASME American Society of Mechanical Engineers
C. ASTM American Society for Testing Materials
D. BICSI Building Industry Consulting Services International
E. EIA Electronic Industries Association
F. ER Equipment Room
G. FCC Federal Communications Commission
H. FM Factory Mutual Insurance Company
I. IEEE Institute of Electrical and Electronics Engineers
J. IRI Industrial Rick Insurers
K. ISD Information Systems Division
L. ISO International Standards Organization
M. NEC National Electrical Code
N. NEMA National Electrical Manufacturers’ Association
O. NESC National Electrical Safety Code
P. NFPA National Fire Protection Association
Q. OSHA Occupational Safety and Health Administration
R. TIA Telecommunications Industry Association
S. TR Telecommunications Room (formerly, telecommunications closet)
T. UFPO Underground Facilities Protective Organization
U. UL Underwriter’s Laboratories, Inc.

1.5 DEFINITIONS

A. Approved / Approval: Written permission to use a material or system.
B. As Called For: Materials, equipment including the execution Specified/shown in the contract documents.
C. Code Requirements: Minimum requirements.
D. Concealed: Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
E. Design Equipment: Refer to the article, BASIS OF DESIGN.
F. Design Make: Refer to the Article, BASIS OF DESIGN.
G. Equal or Equivalent: Equally acceptable as determined by Owner’s Representative.
H. Exposed: Work not identified as concealed.
I. Final Acceptance: Owner acceptance of the project from Contractor upon certified by Consultant.

J. Furnish: Supply and deliver to installation location.

K. Furnished by Others: Receive delivery at job site or where called for and install.

L. Inspection: Visual observations by Owner’s site Representative.

M. Install: Mount and connect equipment and associated materials ready for use.

N. Labeled: Refers to classification by a standards agency.

O. Make: Refer to the article, BASIS OF DESIGN.

P. Or Approved Equal: Approved equal or equivalent as determined by Consultant.

Q. Consultant: The Prime Professional

R. Prime Professional: Architect or Engineer having a contract directly with the Owner for professional services.

S. Provide: Furnish, install and connect ready for use.

T. Relocate: Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use

U. Replace: Remove and provide new item.

V. Review: A general contractual conformance check of specified products.

W. Roughing: Pipe, duct, conduit, equipment layout and installation.

X. Satisfactory: As specified in contract documents.

Y. Site Representative: Construction Manager or Owner’s Inspector at the work site.

Z. Refer to General Conditions of the Contract for additional definitions.

1.6 INTENT OF DRAWINGS

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included. Drawings show approximate locations of equipment, fixtures. Exact locations are subject to the approval of the Consultant.

B. Anything mentioned in the Specifications and not shown in the Drawings, or shown in the Drawings and not mentioned in the Specifications, shall be of like effect as if shown and mentioned in both. In case of differences between the Drawings and the Specifications, the stricter provision as determined by the Consultant shall govern. Omissions from the Drawings or Specifications, or the incorrect description of details of Work which are evidently necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or incorrectly described details of the Work, but they shall be performed as if correctly described in the Contract Documents. Acceptance of this project by the Contractor acknowledges that they have verified all field measurements, field construction criteria, materials, catalog numbers and similar data, or will do so, and that they will check and coordinate each shop drawing and sample with the requirements of the Work and of the Contract Documents.

1.7 REVIEW OF THE CONTRACT DOCUMENTS

A. The contractor shall carefully study and compare the Contract Documents and shall at once report to the Consultant any error, inconsistency or omission he or she may discover. If contractor performs any construction activity knowing it involves a recognized error,
inconsistency or omission in the contract documents without such notice to the Consultant or Owner, the contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable cost for correction.

B. The contractor must verify all dimensions locating the work and its relation to existing work, all existing conditions and their relation to the work and all man made obstructions and conditions, etc. affecting the completion and proper execution of the work as indicated in the Contract Documents.

1.8 EXAMINATION OF THE PREMISES

A. Contractor shall visit Site to familiarize themselves with the local conditions under which the work is to be performed and correlate their observations with the requirements of the Contract Documents. No allowance will be made for claims for concealed conditions, which Contractor, in exercise of reasonable diligence in its observations of the Site and review of the local conditions under which the work is to be performed, learned or should have learned of, unless otherwise specifically agreed by Owner and Consultant in writing.

B. Before ordering any materials or doing any work, the contractor shall verify all measurements and be responsible for correctness of same. No extra charge or compensation will be allowed for duplicate work or material required because of an unverified difference between an actual dimension and the measurement indicated in the drawings. Any discrepancies found shall be submitted in writing to the Project Manager and Consultant for consideration before proceeding with the work.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS MINIMUM REQUIREMENTS

A. Materials shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less, in accordance with NFPA 255.

B. Provide materials that meet the following minimum requirements:

1. All equipment and material for which there is a listing service shall bear a National Recognized Testing Laboratory (NRTL) label.

2. Electrical equipment and systems shall meet UL Standards and requirements of the NESC. This listing requirement applies to the entire assembly. Any modifications to equipment to suit the intent of the specifications shall be performed in accordance with these requirements.

3. Equipment shall meet all applicable FCC Regulations

4. All materials, unless otherwise specified, shall be new and be the standard products of the manufacturer. Used equipment or damaged material will be rejected.

5. The listing of a manufacturer as "acceptable" does not indicate acceptance of a standard or cataloged item of equipment. All equipment and systems must conform to the Specifications and meet the quality of the design make.

6. The Contractor shall furnish and file with the proper Authorities all drawings required by them in connection with this work. The Contractor, if required, shall obtain all official permits, licenses and inspections and shall pay all legal and proper fees and
charges.

7. The Contractor shall at inception of the work provide the Project Coordinator with copies of all required building and trade permits, if said are required.

8. The Contractor shall be responsible for arranging all inspections and for securing all required signatures. Upon completion of the work, properly completed permits shall be returned to the Project Coordinator, if any are required.

2.2 WORKMANSHIP, SUBSTITUTIONS AND WARRANTY

A. Materials and workmanship shall meet or exceed industry standards. Horizontal cabling and all related passive equipment shall be fully guaranteed by TE for a minimum of twenty-five years from final acceptance. All non TE components shall carry a one year warranty. Cable integrity and associated termination’s shall be thoroughly inspected, fully tested and guaranteed as free from defects, transpositions, opens-shorts, tight kinks, damaged jacket insulation, etc.

1. All labor must be thoroughly competent and skilled, and all work shall be executed in strict accordance with the best practice of the trades.

2. Contractor shall be responsible for and make good, without expense to the Owner, any and all defects arising during this warranty period that are due to imperfect materials, appliances, improper installation or poor workmanship.

3. No substitution will be considered unless written request has been submitted by the Bidder to the Consultant and has been approved by the MSU IT representative at least seven (7) days prior to the date for receipt of bids. Each request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution. Provide original product data (no copies will be accepted) with performance and test data and any other information necessary for an evaluation. See Division 1 for further information.

4. After a Contract is awarded, requests to substitute for previously approved materials shall be submitted by the Contractor to the Consultant within seven (7) days, complete with reasons for substitution and savings, which accrue to Owner if substitutes are approved. Substitutes, after Contract award, will be considered only if equal or superior to that specified.

5. Approval of alternate or substitute equipment or material in no way voids Contract document requirements.

6. Under no circumstances shall the Owner be required to prove that an item proposed for substitution is not equal to the specified item. It shall be mandatory that the Contractor submit to the Owner all evidence to support his contention that the item proposed for substitution is equal to the contract specified item. The Owner’s decision as to the equality of substitution shall be final and without further recourse.

2.3 CABLES

A. Any cable associated with this Contract shall be suitable, listed and marked for use in a riser or plenum application unless noted otherwise. For example, riser cable shall minimally be CMR rated for riser spaces and CMP for plenum spaces per the 2014 National Electrical Code and shall meet all local and state codes.

2.4 FACTORY ASSEMBLED PRODUCTS

A. Provide maximum standardization of components to reduce spare part requirements.
B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. All components of an assembled unit need not be products of same manufacturer, but the completed system shall supply the Owner with a minimum manufacturer’s 25-year performance warranty.

2. Constituent parts, which are alike, shall be product of a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.

4. Contractor shall guarantee for the minimum of twenty-five years, the assemblies of components, and shall repair or replace elements of the assemblies as required to deliver complete assembly.

C. Components of equipment shall bear manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

D. Major items of equipment that serve the same function must be the same make and model. Exception will be permitted if performance requirements cannot be met.

2.5 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that a complete and fully operational system will result.

B. Provide maximum standardization of components to reduce spare part requirements.

C. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.

1. Constituent parts that are alike shall be product of a single manufacturer.

2. Contractor shall guarantee assemblies of components, and shall repair or replace elements of the assemblies as required to deliver the complete assembly.

3. Components of equipment shall bear manufacturer's name or trademark, model number and serial number on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.

2.6 SPECIAL TOOLS

A. If any part of equipment requires a special tool for assembly, adjustment or maintenance thereof and such tool is not readily available on commercial tool market, it shall be furnished by the Contractor.

2.7 LIFTING ATTACHMENTS

A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered without bending or distortion of shape, such as rapid lowering and braking of load.

2.8 MISCELLANEOUS SUPPORTS
A. Metal bars, plates, tubing, etc. shall conform to ASTM standards:
   1. Steel plates, shapes, bars, and grating - ASTM A 36
   2. Cold-Formed Steel Tubing - ASTM A 500
   3. Hot-Rolled Steel Tubing - ASTM A 501
   4. Steel Pipe - ASTM A 53, Schedule 40, welded

B. Metal Fasteners shall be Zinc-coated (type, grade and class as required)

2.9 FIRESTOPPING
A. Fire stopping for Openings through Fire and Smoke Rated Walls and Floor Assemblies shall
   be listed or classified by an approved independent testing laboratory for "Through-
   Penetration Fire-Stop Systems." The system shall meet the requirements of "Fire Tests of
   Through- Penetration Fire-Stops" designated ASTM E814.

B. Inside of all conduits, the fire-stop system shall consist of a dielectric, water resistant, non-
   hardening, permanently pliable/re- enterable putty along with the appropriate damming or
   backer materials (where required). The sealant must be capable of being removed and
   reinstalled and must adhere to all penetrants and common construction materials and shall be
   capable of allowing normal wire/cable movement without being displaced.

C. The Contractor shall patch all openings remaining around and inside all conduit, sleeves and
   cable penetrations to maintain the integrity of any fire rated wall, ceiling, floor, etc. The fire-
   stop system shall consist of a dielectric, water resistant, non-hardening, permanently
   pliable/re- enterable putty along with the appropriate damming materials (where required).
   The sealant must be capable of being removed and reinstalled and must adhere to all
   penetrants and common construction materials and shall be capable of allowing normal
   wire/cable movement without being displaced.

D. All building conduits and sleeves installed and/or used under this contract shall be fire-stopped,
   or re-fire-stopped, upon cable placement through such passageways.

E. Manufacturer’s recommended installation standards must be closely followed (i.e.
   minimum depth of material, use of ceramic fiber and installation procedures).

PART 3 – EXECUTION

3.1 ROUGH-IN
A. Before construction work commences, the Contractor shall visit the site and identify the
   exact routing for all horizontal pathways.

B. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in
   elevation, etc. Verify final locations for installation with field measurements and with the
   equipment being connected. Verify exact location and elevations at work site prior to any rough
   in work. If field conditions, details, changes in equipment or shop drawing information require a
   significant change to the original documents, contact the owners representative for approval
   before proceeding.

C. All equipment locations shall be coordinated with other trades, other renovation projects, and
   existing conditions to eliminate interference with required clearances for equipment
   maintenance and inspections.
   1. Coordinate work with other trades, other renovation projects, and existing conditions to
determine exact routing of all cable tray, hangers, conduit, etc., before fabrication and installation. Verify with Consultant exact location and mounting height of all equipment in finished areas, such as equipment racks, communication and electrical devices. Coordinate all work with existing Architecture.

2. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. There will be no priority schedule for trades. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and/or furnish other equipment as required for ample maintenance space. Any changes in the size or location of the material or equipment supplied or proposed, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Consultant and approval received before such alterations are made.

D. Provide easy, safe, and code mandated clearances at equipment racks and enclosures, and other equipment requiring maintenance and operation.

E. The Contractor shall be responsible for all required locations, cutting, patching, coring and associated work for the complete cabling system at no additional cost to the Owner.

3.2 CUTTING AND PATCHING
A. Contractor shall include the required cutting and patching work to perform work. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch and/or paint openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer’s instructions.

3.3 CHASES
A. General:
   1. Assume responsibility for correct and final location and size of such pathways.
   2. Rectify improperly sized, improperly located or omitted conduit due to faulty or late information or failure to check final location.
   3. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Cap or fire stop all unused conduits and sleeves.
   4. Seal voids in fire rated assemblies with a fire-stopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge-galvanized sleeves at fire rated assemblies. Extend sleeves a minimum 2” above floors.
   5. In wall openings, drill or cut holes to suit. Provide 18 gauge-galvanized sleeves at shafts and fire rated assemblies. Provide fire-stopping seal between sleeves and wall in drywall construction. Provide fire stopping similar to that for floor openings.

3.4 SUPPORTS
A. Provide required supports, beams, angles, hangers, rods, bases, braces, straps, struts, and other items to properly support contract work. Supports shall meet the approval of the Consultant. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud
walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For precast Panels/Planks and Metal Decks, support communication work as determined by manufacturer and Consultant. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

3.5 GENERAL INSTALLATION REQUIREMENTS
   A. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.
   B. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.
   C. Set all equipment to accurate line and grade, level all equipment and align all equipment components.
   D. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.
   E. No equipment shall be hidden or covered up prior to inspection by the Consultant and MSU IT representative. All work that is determined to be unsatisfactory shall be corrected immediately.
   F. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.
   G. Contractor shall replace/repair all ceiling tiles or plaster damaged by work performed as part of Division 27 contract.

3.6 PAINTING
   A. Contract includes the following:
      1. Painting for all cut and patch work performed as part of Division 27 contract.
      2. Painting for junction boxes and conduits per Owner’s standards or Division 27 standards.
      3. Painting for damage to existing wall and ceiling surfaces.

3.7 ADDITIONAL ENGINEERING SERVICES
   A. In the event that the Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed to the Contractor.
   B. In the event that the Consultant is required to provide additional engineering services as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents, or if the Consultant is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Consultant's expense in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed to the Contractor.
3.8 FIRE-STOPPING

A. Fire-stopping for Openings through Fire and Smoke Rated Wall and Floor Assemblies:
   1. Provide materials and products listed. The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814. To be used inside all conduits and sleeves. Caulk on exterior of conduit penetration.
   2. Provide fire-stop system seals at all locations where conduit, fiber, cable trays, cables/wires, and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.
   3. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.
   4. The methods used shall incorporate qualities that permit the easy removal or addition of conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating. Typical rating:
      a) Floors - 3 hours
      b) Corridor walls - 2 hours
      c) Offices - ¾ hour
      d) Smoke partitions - ¾ - 1 hour

END OF SECTION 27 01 00
SECTION 27 11 00 – TELECOMMUNICATIONS ROOMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 SCOPE

A. This Section includes the minimum requirements for equipment and cable installations in the Telecommunications Room.

B. Minimum composition requirements and installation methods for the following:
   1. 19" Racks
   2. Cable management
   3. Fiber optic patch panels and accessories
   4. Category 6 patch panels
   5. Building Entrance Terminal
   6. Voice patch panels
   7. 25-pair cable

1.3 QUALITY ASSURANCE

A. All telecommunication room hardware shall be installed in a neat and workmanlike manner in meeting the requirements of the National Electrical Code (NEC). All methods of construction that are not specifically described or indicated in the Contract Documents shall be subject to the control and approval of the Owner's representative. Materials that are specified in this Section shall be of the quality and manufacture indicated. Where "approved equal" is stated, the materials shall be equivalent in every way to that of the material specified, and subject to written approval.

B. Materials and work specified herein shall comply with the latest applicable requirements of:
   1. ANSI/TIA-568-C.0 Generic Telecommunications Cabling for Customer Premises
   2. ANSI/TIA-568-C.1 Commercial Building Telecommunications Standard
   3. ANSI/TIA-568-C.2 Balanced Twisted-Pair Telecommunication Cabling and Components Standard
   4. ANSI/TIA-568-C.3 Optical Fiber Cabling Components Standard
   5. ANSI/TIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces
   6. ANSI/TIA-606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
   7. ANSI/TIA-J-STD-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications
   8. Underwriters Laboratory (UL)
   10. National Electrical Code (NEC)
1.4 SUBMITTALS

A. Provide product data for the following:

1. 19" racks
2. Cable management
3. Fiber optic patch panels
4. Category 6 patch panels
5. Building Entrance Terminal
6. Voice patch panels
7. 25-pair cable

PART 2 – PRODUCTS

2.1 19" RACKS

A. Use racks conforming to EIA Standard 310-D. Refer to drawings for details.

B. Cabinets shall include horizontal wire management features between all components as well as vertical wire management on all sides of the racks.

C. Design Make:
   1. CHATSWORTH, Universal Rack (Part # 46353-5-03), with Chatsworth 12816-701 15-amp horizontal power strip (see T3.01). Verify plug connector with electrical contractor.

2.2 CABLE MANAGEMENT

A. Provide wire management between each component (patch panel, active components, etc.) in all racks as well as vertical management on all sides of racks.

B. Design make:
   1. TE, Horizontal wire manager (Part # 558331-1).
   2. SIEMON , Rear wire minders (Part # WM-BK).
   3. CHATSWORTH, Vertical wire management unit (Part # 11729-5-03).

2.3 FIBER OPTIC PATCH PANELS AND ACCESSORIES

A. Provide fiber optic patch panels as indicated on the drawings.

B. Design make:
   1. CORNING, 2U fiber panel (Part # CCH-02U). Two Required.
   2. CORNING, Fiber optic adapter plate (Part # CCH-CP06-B3). Four required. Blank all unused panels (Part # CCH-BLNK).
   3. CORNING, Splice Cassette (Part # CCH-CS).
   4. CORNING, Buffer tube fan out kit (Part # FAN-BT36-12).
2.4 CATEGORY 6 PATCH PANELS
   A. Provide category 6 patch panels as indicated on the drawings.
   B. Design make:
      1. TE, 48-port Category 6 patch panel (Part # 1375015-2).

2.5 Building Entrance Terminal
   A. Provide building entrance terminal as indicated on the drawings.
   B. Design make:
      2. PORTA SYSTEMS, 5-pin gas-tube protector modules (Part # 175BCXN-230). 50 required.

2.6 Voice Patch Panels
   A. Provide voice patch panels as indicated on the drawings.
   B. Design make:
      1. TE, Voice patch panel (Part # 557403-1).

2.7 25-Pair Cable
   A. Provide 25-pair cable between the building entrance terminal and voice patch panel in the NAIC parking garage. Provide 25-pair cable between building entrance terminal and existing 66-block in the Marga Hoseous Fitness Center.
   B. Design make:
      1. SUPERIOR ESSEX, 25-pair category 3 cable (Part # 18-499-13).

PART 3 - EXECUTION

3.1 EQUIPMENT RACK
   A. The equipment rack shall be constructed using approved methods and materials. Install horizontal wire management between all patch panels and equipment.
   B. Provide all miscellaneous installation hardware such as screws, brackets, hangers, equipment trays, etc., which may not be called out on the drawings, but are required for installation which is acceptable to Engineer MSU IT representative.

3.2 GROUNDING AND BONDING
A. Grounding shall be accomplished by common single-point termination of all ground conductors.

B. Bond metallic equipment rack to the ground bar with #6 ground wire.

C. All connectors and clamps shall be UL Listed, mechanical type, made of silicon bronze.

D. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.

END OF SECTION 27 11 00
SECTION 27 12 00 – PATHWAYS, FITTINGS, AND BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The work in this Section includes conduit and cable support systems required for telecommunications systems. See drawings for additional details.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rigid conduit shall be galvanized rigid steel conforming to Federal Specification No. WW-C-581. Install bushings to protect cabling.

B. Intermediate metal conduit may be used only as permitted by the National Electric Code.

C. EMT shall be galvanized steel conforming to Federal Specification No. WW-C-563. May only be used where rigid steel is not called for or required by Code.

1. Connectors and fittings up through 2” size to be steel compression type (cast metal is not acceptable). Setscrew type is not acceptable up through 2” size.

D. Insulated bushings shall be O-Z/Gedney Type B, SB or SBT as required.

E. Surface raceway systems shall be Wiremold (size 4000 with associated extra deep outlet boxes) or EMT unless otherwise noted and/or approved by the Consultant. Factory finish or field paint to match surface it is mounted on.

F. Cable runway to be Flextray by GS Metals. Install per manufacturer’s recommendations.

G. Outlet boxes used with conduit shall be metal 4-inch square boxes with a minimum depth of 2 1/8” inches with a single gang mud ring unless noted otherwise. Refer to electrical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Raceways shall be used throughout construction for all cables unless otherwise specifically indicated.

B. All conduits shall be provided with lock nuts, insulated throat connectors, and insulated...
bushings.

C. Conduit shall be concealed in finished spaces, unless otherwise indicated.

D. Installation of raceways to be coordinated with installation of other trades, in particular, ductwork and piping. The location of mechanical equipment and systems shall take precedence over raceway location. Installation shall not restrict equipment maintenance space or access thereto.

E. Hanging of raceways done in first-class manner using conduit clamps, Unistrut brackets, racks, etc., or other approved methods. Hanging off ductwork, suspended ceiling support wires or resting on ceiling support system or ceiling material is not permitted. Installation shall not interfere with removable ceiling panels or access openings.

F. Exposed conduit shall be run parallel and/or perpendicular with walls. Use appropriate factory fittings for changes in direction, terminations and connections.

G. Annular openings around conduit penetrating fire barriers such as floors, fire rated walls and fire rated ceilings shall be fire-stopped as specified in Section 27 01 00.

H. Conduit or raceway shall not be run through ductwork.

I. All conduits, regardless of the phase of the project, shall be kept closed so as to prevent the introduction of water, soil or vermin into the conduits or buildings.

J. Conduit shall be used for all locations where cabling penetrates a wall.

K. Conduits shall not exceed 40% fill ratio.

3.2 GROUNDING RACEWAY SYSTEM

A. All non-current carrying metallic parts of electrical equipment and all raceway systems shall be grounded.

B. Ground raceway systems and cabinets for auxiliary systems by bonding or by conduit interconnection with the electrical system or as otherwise specifically indicated on the drawings.
SECTION 27 15 00 - BACKBONE CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 SCOPE

A. This section includes the installation of one I/O 12-strand singlemode fiber optic cable and one category 3 25-pair OSP cable. Refer to drawings for additional details.

1.3 QUALITY ASSURANCE

A. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Materials and work specified herein shall comply with the applicable requirements of:

1. ANSI/TIA-455-A, Standard Test Procedures for Fiber Optic Fibers, Cables and Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components
2. ANSI/ICEA S-80-576, Communications Wire and Cable for Wiring Premises
3. ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable
4. ANSI/ICEA S-87-640, Fiber Optic Outside Plant Communications Cable
5. ANSI/TIA-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant OFSTP-14A
6. ANSI/TIA-598-A, Optical Fiber Cable Color Coding
8. ANSI/TIA–568-C
9. ANSI/TIA–569-B
10. ANSI/TIA-758-B
11. NFPA 70
12. BICSI Telecommunications Distribution Methods Manual
13. FCC 47 CFR 68
14. NEMA – 250
15. NEC - Articles 725, 760 770 and 800 (2011 or newer addition)
16. TSB-72
17. ISO/IEC 11801
1.4 SUBMITTALS

A. Manufacturer's catalog sheets, specifications and installation instructions for all products to be installed within the scope of work included under this contract.

PART 2 - PRODUCTS

2.1 BACKBONE CABLES

A. An I/O 12-strand singlemode fiber optic cable and 25-pair Category 3 OSP cable shall be used for connectivity between the NAIC Parking garage room 103 and Marga Hoseaus Fitness Center room 70TR.

2.2 12-STRAND SINGLEMODE FIBER OPTIC CABLE

A. Design Make: CORNING, 12-strand fiber optic cable (Part # 012EUF-T4101D20)

2.3 25-PAIR CATEGORY 3 OSP CABLE

A. Design Make: SUPERIOR ESSEX, Sealpic 25-pair Category 3 OSP cable (Part # 01-097-40).

PART 3 - EXECUTION

3.1 OPTICAL FIBER CABLE

A. Fiber optic cable not installed in conduit shall be ran in 1" innerduct.

B. Maintain polarization for entire system as described in ANSI/EIA/TIA-568-A section 12.7.1.

C. Cable shall be continuous from source to destination.

D. For the fiber, leave a 15’ service loop at each end of the cable.

E. Adhere to all manufacturers’ requirements regarding pulling tension and allowable lubricants.

F. The contractor shall be responsible for verifying the actual footage’s and distances identified on the drawings (i.e. source to destination).

G. The contractor shall be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

H. The contractor shall assume the responsibility for any difficulties or damage to the cable during placement.

I. Cable shall be supported every 48” on center.

J. Test, label, and document.
3.2 CATEGORY 3 OSP CABLE

A. Cable installation shall conform to industry standards with regard to anchoring, cable support and separation from other facilities.

B. Cable shall not sag or droop but should be installed so as to maintain a flat plane with smooth transitions from one level or direction to another.

C. Cable shall be sufficiently racked and supported in order to eliminate stress on the cable.

D. Cable shall be supported every 48" on center.

E. Cable shall not be allowed to lie on floors, ceiling or ceiling support structure. Cable must be secured in such a way as to not interfere with other services or space access.

F. The contractor shall be responsible for verifying the actual footage's and distances identified on the drawings (i.e. source to destination).

G. The contractor shall be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

H. The contractor shall assume the responsibility for any difficulties or damage to the cable during placement.

I. Test, label, and document. Wiremap testing shall be performed.

PART 4 - INSPECTION, TESTING, AND ACCEPTANCE OF FIBER OPTIC CABLELING

4.1 WORK INCLUDED

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B. In order to conform to the overall project event schedule, the cabling contractor shall survey the work areas and coordinate cabling testing with other applicable trades.

C. In addition to the tests detailed in this document, the contractor shall notify the Owner or the Owner’s representative of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge.

4.2 SCOPE

A. This Section includes the minimum requirements for the test certification, identification and administration of backbone optical fiber cabling.

B. This Section includes minimum requirements for:
   1. Fiber optic test instruments
   2. Fiber optic testing
   3. Identification
4. Labels and labeling
5. Administration
6. Test results documentation
7. As-built drawings

C. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable plant with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber endfaces shall also be verified.

D. Testing shall be performed on each cabling link (connector to connector).

E. Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the owner.
   1. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

F. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and channels and OTDR traces and event tables for multimode and singlemode links and channels. A copy of the tests shall be sent to both the Engineer and MSU IT representative.
   1. Optionally documentation shall also include optical length measurements and pictures of the connector endface.

4.3 QUALITY ASSURANCE

A. All testing procedures and field-test instruments shall comply with applicable requirements of:
   1. ANSI Z136.2, ANS For Safe Use Of Optical Fiber Communication Systems Utilizing Laser Diode And LED Sources
   3. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR.
   4. ANSI/TIA/EIA-455-60A, Measurement of Fiber or Cable Length Using an OTDR.
   5. ANSI/TIA/EIA-455-61A, Measurement of Fiber or Cable Attenuation Using an OTDR.
  10. ANSI/TIA/EIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.
  11. The Owner or the Owner’s representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
12. The Owner or the Owner's representative will select a random sample of 5% of the installed links. The Owner or the Owner's representative shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the Owner.

4.4 SUBMITTALS
A. Manufacturers catalog sheets and specifications for fiber optic field-test instruments including optical loss test sets (OLTS; power meter and source), optical time domain reflectometer (OTDR) and inspection scope.
B. A schedule (list) of all optical fibers to be tested.
C. Sample test reports.

4.5 ACCEPTANCE OF TEST RESULTS
A. Unless otherwise specified by the Owner or the Owner's representative, each cabling link shall be in compliance with the following test limits:

1. Optical loss testing
   a) Backbone (singlemode) link
      1) The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA/EIA-568-C.1:
         (i) Link Attenuation (dB) = Cable_Atttn (dB) + Connector_Atttn (dB) + Splice_Atttn (dB)
         (ii) Cable_Atttn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
         (iii) Connector_Atttn (dB) = number_of_connector_pairs * connector_loss (dB)
         (iv) Maximum allowable connector_loss = 0.75 dB
         (v) Splice_Atttn (dB) = number_of_splices * splice_loss (dB)
         (vi) Maximum allowable splice_loss = 0.3 dB
         (vii) The values for the Attenuation_Coefficient (dB/km) are listed in the table below:

         | Type of Optical Fiber                  | Wavelength (nm) | Attenuation coefficient (dB/km) | Wavelength (nm) | Attenuation coefficient (dB/km) |
         |----------------------------------------|-----------------|---------------------------------|-----------------|---------------------------------|
         | Single-mode (Outside plant)            | 1310            | 0.5                             | 1550            | 0.5                             |

2. OTDR testing
   a) Reflective events (connections) shall not exceed 0.75 dB.
   b) Non-reflective events (splices) shall not exceed 0.3 dB.
3. Magnified endface inspection
a) Fiber connections shall be visually inspected for endface quality.

b) Scratched, pitted or dirty connectors shall be diagnosed and corrected.

B. All installed cabling links and channels shall be field-tested and pass the test requirements and analysis as described in Part 6. Any link or channel that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation in accordance with Part 6.

C. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Engineer and IT representative.

PART 5 - PRODUCTS

5.1 OPTICAL FIBER CABLE TESTERS

A. The field-test instrument shall be within the calibration period recommended by the manufacturer.

B. Optical loss test set (OLTS)

1. Singlemode optical fiber light source
   a) Provide dual laser light sources with central wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).
   b) Output power of –10 dBm minimum.

2. Power Meter
   a) Provide 1310 nm and 1550 nm wavelength test capability.
   b) Power measurement uncertainty of ± 0.25 dB.
   c) Store reference power measurement.
   d) Save at least 100 results in internal memory.
   e) PC interface (serial or USB).

3. Optional length measurement
   a) It is preferable to use an OLTS that is capable of measuring the optical length of the fiber using time-of-flight techniques.

C. Optical Time Domain Reflectometer (OTDR)

1. Shall have a bright, color transmissive LCD display with backlight.
2. Shall have rechargeable Li-Ion battery for 8 hours of normal operation.
3. Weight with battery and module of not more than 4.5 lb and volume of not more 200 in³.
4. Internal non-volatile memory and removable memory device with at least 16 MB capacity for results storage.
5. Serial and USB ports to transfer data to a PC.
6. Singlemode OTDR
a) Wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).
b) Event deadzones of 2 m maximum at 1310 nm and 2 m maximum at 1550 nm.
c) Attenuation deadzones of 15 m maximum at 1310 nm and 15 m maximum at 1550 nm.
d) Distance range not less than 10000 m.
e) Dynamic range at least 10 dB at 1310 nm and 1550 nm

D. Fiber Microscope
1. Magnification of 250X or 400X for endface inspection
2. Optional requirements
   a) Video camera systems are preferred.
   b) Camera probe tips that permit inspection through adapters are preferred.
   c) It is preferable to use test equipment capable of saving and reporting the endface image.

E. Integrated OLTS, OTDR and fiber microscope
1. Test equipment that combines into one instrument an OLTS, an OTDR and a fiber microscope may be used.

5.2 IDENTIFICATION
A. Labels
1. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
2. Shall be preprinted using a mechanical means of printing (e.g., laser printer).
3. Where used for cable marking, provide vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
4. Where insert type labels are used provide clear plastic cover over label.

5.3 ADMINISTRATION
A. Administration of the documentation shall include test results of each fiber link and channel.
B. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
C. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

PART 6 – EXECUTION
6.1 GENERAL
A. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.
B. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

6.2 OPTICAL FIBER CABLE TESTING

A. Field-test instruments shall have the latest software and firmware installed.

B. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

C. Fiber endfaces shall be inspected at 250X or 400X magnification. 250X magnification is suitable for inspecting singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers. Scratched, pitted or dirty connectors shall be diagnosed and corrected.

D. Testing shall be performed on each cabling segment (connector to connector).

E. Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use per the owner's instructions.

F. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length. The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.

G. Optical loss testing
   1. Backbone link
      a) Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method.
      b) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
      c) Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. The user shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

H. OTDR Testing
   1. Backbone, horizontal and centralized links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.
   2. Each fiber link and channel shall be tested in one direction.
   3. A launch cable shall be installed between the OTDR and the first link connection.
   4. A receive cable shall be installed after the last link connection.

I. Magnified Endface Inspection
   1. Fibers shall be inspected at 250X or 400X magnification. 250X magnification is suitable for inspecting singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers.

J. Length Measurement
   1. The length of each fiber shall be recorded.
2. It is preferable that the optical length be measured using an OLTS or OTDR.

K. Polarity Testing

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with subclause 10.3 of ANSI/TIA/EIA-568-B.1. The polarity of the paired duplex fibers shall be verified using an OLTS.

6.3 IDENTIFICATION

A. Labeling

1. Labeling shall conform to the requirements specified within ANSI/TIA/EIA-606-B or to the requirements specified by the Owner or the Owner’s representative.

6.4 ADMINISTRATION

A. Test results documentation

1. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”. The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the MSU IT representative during the installation period and shall be passed to the MSU IT representative within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.

3. The database for the complete project, including twisted-pair copper cabling links, if applicable, shall be stored and delivered on CD-ROM prior to MSU IT representative acceptance of the building. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.

4. Circuit IDs reported by the test instrument should match the specified label ID (see 6.3 of this Section).

5. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information:
   a) The identification of the customer site as specified by the end-user
   b) The name of the test limit selected to execute the stored test results
   c) The name of the personnel performing the test
   d) The date and time the test results were saved in the memory of the tester
   e) The manufacturer, model and serial number of the field-test instrument
   f) The version of the test software and the version of the test limit database held within the test instrument
   g) The fiber identification number
   h) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
   i) Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
j) The length for each optical fiber as calculated by the OTDR.

k) The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements

l) Optional
   1) A picture or image of each fiber end-face
   2) A pass/fail status of the end-face based upon visual inspection.

B. Record copy and as-built drawings

1. Provide record copy drawings periodically throughout the project as requested by the MSU IT representative, and at end of the project on CD-ROM. Record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as-built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point. CAD drawings are to incorporate test data imported from the test instruments.

2. The as-built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details. The as-builds shall include all field changes made up to construction completion:
   a) Field directed changes to pull schedule.
   b) Field directed changes to cross connect and patching schedule.
   c) Horizontal cable routing changes.
   d) Backbone cable routing or location changes.
   e) Associated detail drawings.

END OF SECTION 27 15 00
SECTION 271600 – HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 WORK INCLUDED
A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.2 SCOPE OF WORK
A. Horizontal cabling is the portion of the cabling system that extends from the work area to the patch panels. The horizontal cabling shall be configured in a star topology. The horizontal cabling includes the horizontal cables, the mechanically terminated jacks/inserts and the faceplates that the jacks/inserts snap into in the work area.

B. This section includes minimum requirements for the following:
   1. Category 6 and UTP Cable from TR to Work area
   2. Faceplates and Jacks
   3. Installation and Termination Methods
   4. Testing

1.3 QUALITY ASSURANCE
A. All cable shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of MSU IT representative. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Strictly adhere to all Category 6 installation practices when installing UTP cabling.

C. Materials and work specified herein shall comply with the latest applicable requirements of:
   1. ANSI/ICEA S-80-576-1988, Communications Wire and Cable for Wiring Premises
   2. NFPA 70, 1996, National Electrical Code
   3. ANSI/TIA/EIA – 568-C Telecommunications Cabling Standard
   4. ANSI/TIA/EIA – 569-A Pathway and Spaces
   5. BICSI Telecommunications Distribution Methods Manual
   6. FCC 47 CFR 68
   7. NEMA – 250
   8. NEC - Articles 770 and 800
   9. ADA - Americans with Disabilities Act
1.4 SUBMITTALS
A. Manufacturers catalog sheets, specifications and installation instructions for all products in this section.

PART 2 - PRODUCTS

2.1 COPPER TELECOMMUNICATIONS HORIZONTAL CABLE
A. 4-pair, 23 gauge, Category 6 UTP copper telecommunications horizontal cable shall be used for connectivity between the telecommunications closets and work area outlets. Cable will be placed in conduit, J-Hooks, and/or cable tray spaced no greater than 48” O.C.
B. The cable shall conform to requirements of ANSI/TIA/EIA-568-C and applicable specifications of 4-pair cable within ANSI/ICEA S-80-576.
C. Design Make:
   1. TE, Outdoor Category 6, Black, (Part #: TE6200SP-BK02).

2.2 OUTLETS
A. All Category 6 and outlets shall conform to ANSI/TIA/EIA-568-C.
B. All outlets shall be wired to T568B as specified in ANSI/TIA/EIA-568-C.
C. Design Make:
   1. TE, Etherseal Modular Jack and Coupler kit, (Part # 0-1479565-2)

2.3 OUTLET HOUSINGS AND FACEPLATES
A. Provide faceplates for each outlet indicated on the drawings. Provide blanks for any unused ports.
B. Design Make:
   1. TE, 2-port Etherseal stainless faceplate, (Part # 0-1479594-2)
   2. TE, Surface mount box, (Part # 0-0558251-1)

PART 3 - EXECUTION

3.1 INSTALLATION
A. The maximum pulling tensions specified by the cable manufacturers shall not be exceeded. Contractor shall use tools and equipment specifically designed for the pulling of cable. The contractor shall implement installation practices that ensure the highest quality installation. Contractor shall make all cutting, splicing, pulling and termination of cables using equipment specifically designed for that purpose.
B. Contractor shall install tie wraps so that they spin freely on cable bundles. Tie wraps and other securing hardware shall be rated as required for the installation environment (i.e., tie wraps will be approved for use in a plenum area when installed in a return air space). Contractor shall fill cable tray or conduit with cables using the following guidelines:

1. Where cable trays or conduits are stacked, the contractor shall fill the top raceway to its maximum fill ratio first and then move to the next raceway below it and so on.

2. Where multiple conduits are being used, the contractor shall fill one conduit to its maximum fill ratio before going on to the next conduit. Wherever possible, the contractor shall leave as many spare conduits available as possible. The maximum fill ratios for some typical raceway using telecommunications cabling are as follows.
   a. Ladder type cable tray 40%.
   b. Solid bottom cable tray 40%.
   c. EMT type conduit 40%.

3. The contractor shall not exceed the maximum fill ratio, per the NEC, for any reason. All spare conduits or conduits filled with less than the maximum allowed fill ratio shall have a pull string installed and left for future pulling in of cable. Clearly label as "pulling line" indicating To/From.

4. Contractor shall support cables running overhead that are not installed in raceway by J-hooks spaced no more than 4 feet on center. Openings around electrical raceway penetrations shall maintain the fire resistance rating required. See NEC 300-21. Install cable trays in accordance with NEC Article 318 and manufacturers' recommendations.

C. Install all connectors in conformance with manufacturer recommended procedures. Use tools designed for this purpose. All cables shall be labeled at both ends. The label shall be permanent. Labels shall be typed (not handwritten). All cable labeling shall include numeric designation, source, destination, and cable type. Label each equipment rack, patch panel, and cross connect block uniquely. Contractor shall maintain one set of drawings on site to continually maintain an accurate record of the as-constructed work. The mark-up drawings shall accurately indicate location of equipment, pull-boxes, conduits, cable types and labeling. Provide the marked up drawings to the Consultant prior to final walkthrough with completed project checklist.

D. All wiring concealed in walls or soffits shall be installed in metal conduits.

E. All exposed wiring shall be installed in surface raceway or cable tray.

F. All wiring above ceilings shall be installed in cable tray, J-Hooks, or open top cable hangers NO GREATER THAN 48" O.C.

G. Cable above accessible ceilings shall be supported at no more than 48" on center by approved cable support attached to building structure.

H. Do not untwist cable pairs more than 0.5 in. when terminating.

I. The Contractor shall be responsible for replacing all cables that do not pass Category 6 requirements.

J. Maximum length of cable between the telecommunications closet and the work area outlet shall be 76 meters.

K. Cable shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.
L. Install cable in neat and workmanlike manner. Neatly bundle and tie all cable in closets. Leave sufficient cable for 90-degree sweeps at all vertical drops.

M. Maintain the following clearances from EMI sources for all Category 6 wiring.
   1. Power cable - 6 in.
   2. Fluorescent Lights - 12 in.
   3. Transformers - 36 in.

N. Do not install cable in common cable hangers with audio cable.

O. Do not install Category 6 cable with more than 110N (25 lbs) pull force, as specified in EIA/TIA and BICSI TDDM practices. Utilize appropriate cable lubricant in sufficient quantity to reduce pulling friction to acceptable levels on: long pulls inside conduit, pulls of multiple cables into a single small bore conduit, on conduit runs greater than 100 lineal feet with bends of opposing directions, and in conduit runs that exceed 180 degrees of accumulated bends. Use of tensile rated cords (i.e. fishing line) should be used for difficult or questionable pulls - to judge go/no-go condition of the conduit and pulling setup.

P. Cable jackets that are chaffed or burned exposing internal conductor insulation or have any bare copper ("shiners") shall be replaced.

Q. Firestop all openings where cable is installed through a fire barrier.

R. Provide a minimum 12" of cable slack above each communications outlet and 24" of slack in each telecommunications room.

3.2 INSERTS AND FACEPLATES

A. Outlet boxes shall be secured to building with mechanical fasteners. Adhesive fasteners are not allowed.

B. All extra openings to be filled with blank inserts.

C. Terminate cable per TIA/EIA T568B standard pin assignments.

D. Locate so that combined length of cables and cords from panel to phone or computer does not exceed 3m.

PART 4 - INSPECTION, TESTING, AND ACCEPTANCE OF COPPER CABLING

4.1 REQUIREMENTS

A. Visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are to be returned to the supplier and replaced at no additional cost to the Owner.

B. If the manufacturer of cables or connecting hardware has supplied post-manufacture performance data, copies of such data are to be kept for inclusion in the Documentation and
made available to the Owner upon request.  
All materials are to be new and unused.

C. Contractor is responsible for supplying all of the required test equipment used to conduct acceptance tests.

4.2 TEST PROCEDURES

A. Owner reserves the right to be present during any or all testing.  Contractor shall notify Owner of their intent to test 48 hours before beginning said tests.

B. Testing shall be of the Permanent Link.  However, Contractor shall warrant performance based on Channel performance and provide patch cords that meet channel performance.

C. All cabling not tested strictly in accordance with these procedures shall be re-tested at no additional cost to the Owner.

D. 100% of the installed cabling shall be tested.

4.3 STANDARDS COMPLIANCE AND TEST REQUIREMENTS

A. Cabling must meet TIA 568C.2 Category 6 performance specifications for horizontal cabling.

B. Test reports shall include the following information for each cabling element tested:

C. Wiremap results that indicate the cabling has no shorts, opens, miswires, split, reversed, or crossed pairs, and end-to-end connectivity is achieved.

D. For Category 6 cabling: NEXT, PSNEXT, Return Loss, Insertion Loss, ACR, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin.  Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.  Any additional tests required by the cable Manufacturer for warranty purposes shall be run.  Any individual test that fails the relevant performance specification shall be marked as a FAIL.

E. Length, propagation delay, and delay skew relative to the relevant limit.  Any individual test that fails the relevant performance specification shall be marked as a FAIL.

F. Cable manufacturer, cable model number/type, and NVP.

G. Tester manufacturer, model, serial number, hardware version, and software version.

H. Circuit ID number and project name.

I. Autotest specification used.

J. Overall pass/fail indication.

K. Date of test.

L. Test reports shall be submitted within 7 business days of completion of testing.
4.4 STANDARDS COMPLIANCE AND TEST REQUIREMENTS

A. Test reports may be submitted in hardcopy or electronic format. Hand-written test reports are not acceptable.

B. Hardcopy reports are to be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of all tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, date of test, and pass/fail result.

C. Electronic reports are to be submitted or CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.

4.5 TEST EQUIPMENT

A. Test equipment used under this contract shall be from manufacturers that have A MINIMUM of 5 years experience in producing field test equipment. Manufacturers must be ISO 9001 certified. Tester must be an approved tester of the cabling Manufacturer being used on this project.

B. All test tools of a given type shall be from the same manufacturer, and have COMPATIBLE ELECTRONIC results output.

C. The manufacturer of the test equipment must approve test adapter cables. Adapters from other sources are not acceptable.

D. Baseline accuracy of the test equipment must meet or exceed TIA Level III, as indicated by independent laboratory testing.

E. Test equipment must be capable of certifying Category 6 links.

F. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.

G. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.

H. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.

I. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to autotests. Individual tests increase productivity when diagnosing faults.

J. Test equipment must include a library of cable types, sorted by major manufacturer.

K. Test equipment must store at least 1000 Category 6 autotests in internal memory.

L. Test equipment must be able to internally group autotests and cables in project folders for good records management.
M. Test equipment must include DSP technology for support of advanced measurements.

N. Test equipment must make swept frequency measurements in compliance with TIA standards.

O. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.

4.6 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted, and MSU IT representative is satisfied that all work is in accordance with contract documents, the MSU IT representative shall notify Contractor in writing of formal acceptance of the system.

B. Acceptance shall be subject to completion of all work and successful post-installation testing which yields 100% PASS rating.

END OF SECTION 27 16 00
SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. The electrical contractor, through subcontract with an authorized Fire Alarm Contractor, shall furnish and install, complete and ready for operation, an intelligent, addressable, digital Fire Alarm System, including panel, detectors, pull stations, door holders, local alarms, wiring, remote booster power supplies, signal appliances, and any and all other equipment necessary for a complete operational system, as shown on the drawings and indicated herein.

B. The Fire Alarm Contractor shall be licensed by the State in which the project is located. All fire alarm equipment shall be installed exclusively by installers and workmen that are employees of the fire alarm system contractor. All installers and workmen shall be National Institute for Certification in Engineering Technologies (NICET) certified for fire alarm systems at level two or greater. All submittal preparers shall be resident NICET level three in fire alarm and shall be state licensed. Contractors and workmen not complying with this specification shall not be allowed to perform this work.

C. The Fire Alarm Contractor shall prepare plans and calculations required by the authority having jurisdiction (AHJ), shall submit all required documents to the AHJ for approval, and shall obtain all necessary permits or approvals from the AHJ including anything required prior to installation and/or after completion and testing.

D. Fire Alarm System shall match all MSU rules and standards.

E. The Fire Alarm Control panel shall be network compatible to provide a fire alarm network to or from future buildings, UL listed.

F. The electrical contractor shall provide for all rough-in (including supply and installation of electrical boxes and raceways) and wire pulling. The fire alarm contractor shall supply wiring and any specialty back-boxes required for the fire alarm contractors equipment. The electrical contractor shall NOT install any fire alarm system components beyond rough-in and wire pulling. The fire alarm contractor shall coordinate all requirements with the electrical contractor prior to bidding.

G. All portions of the systems shall be installed in accordance with the drawings, details, and specifications or as required by jurisdictional authorities and codes. Jurisdictional authorities and codes shall take precedence over plans, details and specifications in the event of a dispute between the requirements of contract documents and jurisdictional authorities or codes.

H. The position is taken that the Owner is entitled to a project which meets or exceeds the minimum requirements of nationally recognized fire protection standards. All efforts and installations shall be directed toward this end. All deficiencies as noted by fire rating bureaus, insurance service offices or jurisdictional authorities shall be corrected. No extra charges will be allowed on this account.

I. The fire alarm subcontractor shall coordinate all requirements with the electrical, sprinkler, fire protection, elevator, temperature control and/or other subcontractors. Any additional requirements or detail not shown on the drawings, but required for a complete working integrated system will be the responsibility of the fire alarm subcontractor.
J. Temperature control contractor shall connect to appropriate devices or modules provided and installed by fire alarm subcontractor to accomplish HVAC control and shutdown.

K. Work to be performed under this section shall include, but not be limited to the following:

1. Fire Alarm System
   a. Control Panel
   b. Programming
   c. Audible/Visual Alarm Devices
   d. Pull Stations
   e. Smoke/Heat Detectors
   f. Door Holders
   g. Interface to Elevator Shunt Trip or Starter Equipment
   h. Monitoring of Elevator Shunt Trip or Starter Control Voltage
   i. Interface to Fire Sprinkler Switches and Solenoid Valve
   j. Interface to HVAC Equipment.
   k. Interface to fire/smoke dampers including packaged smoke detectors, where present
   l. Installation of Auto-Dialer.

1.2 RELATED WORK

A. All work performed under this section of the specifications shall be subject to the requirements of both the General and Special Conditions and the Mechanical and Electrical Specification.

1.3 REGULATORY AGENCIES

A. The term jurisdictional authority used in this section of the specification shall include, as applicable, but not be limited to the following:

1. Local Building Department and Fire Department.
3. Insurance Services Office or Insuring Authority having jurisdiction.
4. Owner.

B. The design and installation of all systems of fire protection shall conform to all requirements of applicable codes and publications herein defined:

1. International Building Code
2. International Fire Code
3. NFPA #72
4. NFPA #70
5. All State and local ordinances
6. Underwriters Laboratories.
7. Factory Mutual.
10. Occupational Safety and Health Administration.
11. Americans with Disabilities Act
1.4 SUBMITTALS

A. The successful Contractor shall provide submittal data as required under other portions of these specifications. Submittals shall conform to the instructions set forth in the General and Special Conditions of these specifications entitled Shop Drawings and Submittals.

B. The contractor shall submit to the authority having jurisdiction (AHJ) all necessary documents, plans, calculations and any other details required by NFPA and the AHJ necessary to receive approval and permitting from the AHJ for the work required. Submit plans to the State Health department when required for proper review of project.

C. Should the AHJ require professionally engineered (P.E) stamped plans the contractor shall engage the proper engineering services, at contractors cost to meet the requirements of the AHJ at no additional cost to the project.

1.5 JOB CONDITIONS

A. The Contractor shall determine, and be responsible for, the proper locations and character of inserts for hangers, chases, sleeves, and other openings in the construction required for fire alarm system work, and shall obtain this information well in advance of the construction progress to avoid delay of the work.

B. All fees and permits specifically required for fire alarm work, not obtained by others as specified elsewhere shall be applied for and paid for by the fire alarm contractor.

1.6 OPERATION AND MAINTENANCE MANUALS

A. Three (3) sets of operating and maintenance instructions shall be provided the Owner upon completion.

1.7 TRAINING

A. The fire alarm contractor shall supply on-site training at the owner's facility to familiarize the Owner with the basic operation of the system.

1.8 GUARANTEES AND WARRANTIES

A. The Fire Alarm Contractor shall guarantee to the Owner in writing, all equipment and workmanship for a period of one (1) year after the fire alarm system has been placed in continuous service and has been accepted by all authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Approved Manufacturers/Installers:
1. Simplex.
2. Notifier
3. Edwards

2.2 CONTROL PANEL

A. General Requirements for Fire-Alarm Control Unit:
   1. Field-programmable, microprocessor-based, modular, power-limited design with electronic
      modules, complying with UL 864 and listed and labeled by an NRTL.
      a. System software and programs shall be held in flash electrically erasable programmable
         read-only memory (EEPROM), retaining the information through failure of primary and
         secondary power supplies.
      b. Include a real-time clock for time annotation of events on the event recorder and printer.
   2. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-
   alarm control unit and addressable system components including annunciation and supervision.
   Display alarm, supervisory, and component status messages and the programming and control menu.
   1. Some systems have 40-character display unit that may be adequate for small projects.
   2. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.

C. Keypad: Arranged to permit entry and execution of programming, display, and control commands and
   to indicate control commands to be entered into the system for control of smoke-detector sensitivity and
   other parameters.

D. Fire Alarm Network Compatible, UL listed network.

2.3 DETECTORS

A. SMOKE – Edwards SIGA-IS or equal.

B. HEAT – Edwards SIGA-HRS or equal.

C. DUCT DETECTOR – Edwards SIGA-DH housing with appropriate detector and sample tube. In smaller
   ducts, where code allows, a standard detector may be installed inside the duct in place of a detector
   with sample tube. In larger ducts provide duct detector suitable for no flow detection, or provide a duct
   detector along with a standard detector mounted inside the duct.

D. Smoke detectors shall not be installed until the project has undergone FINAL cleaning in accordance
   with NFPA 72. In the event detectors are installed prior to final cleaning, the contractor shall clean or
   replace all detectors at no additional cost to the Owner. Installation of protective plastic covers does not
   meet the intent of this requirement.

2.4 MANUAL PULL STATIONS

A. Edwards SIGA-278 or equal.
2.5 ALARM DEVICES

A. HORN/STROBES - Edwards or equal.

   1. Provide appliance and backbox suitable for outdoor installation.

2.6 WIRE AND CONDUIT

A. All wiring shall be installed in accordance with NFPA #70 (NEC).

B. All wiring shall be in conduit. Conceal as feasible.

C. All junction boxes shall be painted red and labeled "Fire Alarm".

PART 3 - EXECUTION

3.1 DESIGN CRITERIA

A. Approximate fire alarm devices, alarm panel, horn/strobes, and detector arrangement is indicated on the drawings. Contractor is responsible for all required devices and locations.

B. The entire fire alarm system is not shown on plans. The intent is to provide complete fire alarm systems as required. This Contractor shall be responsible for preparing working drawings for the total system. Contractor shall provide additional devices as required.

C. The contractor shall provide a smoke detector at the fire alarm control panel as shown on the plans. The contractor shall provide additional detectors at any other control units or sub-panels required by their system design if required by the Authority Having Jurisdiction.

D. Where the fire alarm system interlocks to a shunt-trip circuit breaker or other device providing power to an elevator, the contractor shall provide the means to monitor the control circuit voltage of the circuit breaker or starter. In the event control voltage is lost, the fire alarm system shall annunciate the problem and relay the information via the auto-dialer.

E. The location and quantity of fire sprinkler flow and tamper switches shown on the plans are approximate. Final location and quantity is determined by the fire sprinkler contractor’s design. The fire alarm contractor is responsible to coordinate all fire sprinkler switches with the fire sprinkler contractor and connect to all switches installed whether shown on the plans or not.

F. Audible Notification Appliances: Corridor and hall notification appliances are all shown as audible/visual. The contractor shall install the minimum number of audible/visible devices required to achieve minimum sound requirements of NFPA 72. All other corridor and hall notification devices, beyond this minimum, shall be installed as visual notification appliances.

G. Provide the following at each smoke damper and fire/smoke damper:

   1. If smoke and fire/smoke dampers are packaged with an integral smoke detector, provide a module to monitor the smoke detector packaged with the damper. Connect the module to an auxiliary contact on the smoke detector or a position switch on the damper (if so equipped). Provide a blinking red L.E.D. remote alarm in an accessible location that provides a visual
indication when the smoke detector alarms and the damper is closed. Install the L.E.D. alarm indicator in the ceiling below the damper. Label the L.E.D. alarm indicator with the air handler identification tag from which the duct is fed.

2. If smoke and fire/smoke dampers are not packaged with integral smoke detection, provide a relay module to cut power to the damper, resulting in the closure of the damper. Provide a blinking red L.E.D. remote alarm in an accessible location that provides a visual indication when the smoke detector alarms and the damper is closed. Install the L.E.D. alarm indicator in the ceiling below the damper. Label the L.E.D. alarm indicator with the air handler identification tag from which the duct is fed.

3. Provide 120v power to each damper. If indicated on plans, provide power as directed. If not indicated on the plans, provide power from nearest unswitched 120v source.

3.2 SYSTEM OPERATION

A. The system shall be activated by pull station or active initiation devices. Upon any alarm in the system the following shall happen:

1. All indicating appliances shall activate in all areas until silenced by the alarm silence switch at the control panel.
2. All control relays shall change state.
3. All information shall be added to the history log of the panel.
4. A signal shall be transmitted to the digital dialer as to the location of the alarm input. Ability to transmit each alarm point is required. Dialer is to be provided in the contract as well as two years of “off site monitoring” by a UL listed fire alarm central station.

B. The alarm activation of any smoke detector shall initiate the closure of all HVAC fire/smoke dampers. This shall be done following a 10 second delay to ensure related HVAC equipment has shut down so ducts are not damaged by over-pressurization.

C. The system shall interface with the facility elevator to accomplish elevator recall/capture functions. The system shall interface to the elevator shaft vent, where present, causing the vent to open if smoke is detected in the shaft.

D. The system shall interface to the elevator main power supply to cut power in the event of heat detection in the elevator shaft or machine room.

E. The system shall monitor the fire sprinkler system and shall alarm if sprinkler flow is detected. In this event, the system shall cause the domestic water solenoid valve to close. Tamper switch activation shall initiate a trouble, not general, alarm.

F. The system shall continuously check for malfunctions or troubles. Upon detecting any fault the following shall occur.

1. Activate a reporting signal tone at main panel.
2. Indicate the point location on the main F.A. panel as to the location and type of the fault.
3. Add all information to the history log of the panel.

3.3 INSTALLATION

A. Final connections between all fire alarm equipment and the wiring system shall be made only by or under the supervision of an authorized representative of the system manufacturer.
B. The fire alarm contractor shall provide red labels:

1. On the fire alarm control panel indicating the panel and circuit supplying power to the panel.
2. Next to the circuit breaker inside the panel supplying power to the fire alarm control panel stating "FIRE ALARM CIRCUIT CONTROL".

3.4 FINAL TESTS AND REPORT

A. Upon completion of the installation and system tests, the certified test technician shall submit to the Architect three copies of a written report on forms provided by the manufacturer, to indicate the system has been fully tested in supervision, trouble and alarm modes and is fully operational conforming to the letter of these Specifications.

3.5 SYSTEM INSPECTIONS

A. The contractor shall provide two inspections of each system under this Contract during the one (1) year warranty period. The first inspection shall be at the six month interval after system acceptance and the second at the 12 month interval. Inspections shall include confirmation that the system is in proper working order. Inspections shall also include a complete checkout of the control and alarm system. Documents certifying satisfactory system conditions shall be submitted to the Owner's technical representative upon completion of each inspection.

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**Architects: A&E / ZGF**

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**Civil, Geotech, Transportation, and Survey Engineers: DOWL HKM**

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SECTION 31 10 00 – SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and removing site utilities.

1.2 RELATED REQUIREMENTS:

1. Section 31 2000 - Earth Moving.
2. Section 023200 "Geotechnical Data" for geotechnical report and recommendations for the site.
3. Section 024100 "Site Demolition" for demolition of existing site improvements.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:
2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

C. Related Sections:

1. Section 023200 "Geotechnical Data" for geotechnical report and recommendations for the site.
2. Section 024100 "Site Demolition" for demolition of existing site improvements.

1.4 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
B. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and as defined by landscape architect.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.5 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Contractor before performing work.

1. Do not proceed with work on adjoining property until approved by landowner.

C. Utility Locator Service: Notify One Call for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 023200 "Geotechnical Data" within geotechnical report.

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others
unless permitted under the following conditions and then only after arranging to provide temporary utility
services according to requirements indicated:

1. Coordinate utility interruption with City of Bozeman personnel.

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below
exposed subgrade.
3. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further
excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each
layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other
objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape
stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new
construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of
existing pavement to remain before removing adjacent existing pavement. Saw-cut faces
vertically.
3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 RELATED REQUIREMENTS:

A. Section 232000 Geotechnical Investigation
B. Section 311000 - Site Clearing.
C. Section 331000 Water Distribution Piping
D. Section 333000 Sanitary Sewer
E. Section 334100 Strom Utility Drainage Piping
F. Section 321216 Asphalt Paving
G. Section 321313 Concrete Paving

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:

2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.
1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt and or concrete paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.
   2. Controlled low-strength material, including design mixture.
   3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698.

C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.8 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Call Before You Dig" and the Campus Locates for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 312500 "Erosion and Sediment Control," are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Obtain approval from the Architect for all fill before placing soil. Satisfactory fill material shall be free of rock or gravel larger than [3 inches (75 mm)] in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
C. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; 3” minus in compliance with the Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; 1.5” minus in compliance with the Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

E. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; Type 1 Pipe Bedding in compliance with the Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

F. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.

2.2 GEOTEXTILES

A. Separation Geotextile: Propex 350ST woven geotextile fabric, manufactured for separation applications, or approved equal.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, Type II or Type III.
2. Fly Ash: ASTM C 618, Class C or F.

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.
   1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.


B. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

### 3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent erosion and windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.


### 3.12 SOIL FILL

A. Fill to be in compliance with the Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

### 3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Compaction to be in compliance with the Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

B. All existing fill and deleterious material should be removed in their entirety from the proposed building footprint. All exposed subgrade surfaces should be free of mounds and depressions which could prevent uniform compaction. If unexpected fill or obstructions are encountered during site clearing or excavation, such features should be removed and the excavation should extend to the natural soils and thoroughly cleaned prior to fill placement and construction.

C. All fill and backfill should be approved by the geotechnical engineer, moisture conditioned and placed in 8-inch loose lifts. The fill and backfill should then be compacted with an appropriately sized compactor to the following minimum dry densities as determined by ASTM D698.

1. Below Foundations = 98 percent
2. Around Foundations = 95 percent
3. All Other Fill = 95 percent

D. No fill should be placed over frozen ground or in a frozen condition. All loose disturbed soil and/or fills in the base of the over-excavation should be removed from the foundation excavation prior to placement of structural fill. Footings should not be placed on either uncompacted disturbed native soils, or uncontrolled fill. Qualified personnel should observe all footing and slab subgrades to confirm subsoil conditions.

E. Imported gravel meeting the below specifications or the site soils may be used as foundation wall backfill provided proper moisture conditioning to near optimum moisture (± 2 percent) and compacted in accordance with the details presented above. If backfill is needed below foundations, only imported gravel meeting the specifications below should be used. Other imported gravel options may be used by approval of the geotechnical engineer.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>25-60</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 12</td>
</tr>
</tbody>
</table>

| Liquid limits less than 25 and PI less than 6 |

F. Surface water should not be allowed to accumulate and infiltrate soils near the proposed foundations. It must be controlled and directed away from the structures. A simple means of reducing moisture
changes is to prevent surface water infiltration by sloping the ground away from the foundation. The recommended minimum slope within 10 feet of the building is 1 inch vertical for 1 foot horizontal. The sloped ground should be initially constructed at a greater slope to account for settlement/consolidation of exterior backfill. Within 10 feet of the foundation, the upper 12 to 18 inches of backfill should consist of less permeable, compacted clay soils. The area around the foundation should be inspected regularly, particularly after a rain event to determine if proper drainage away from the structure has been maintained.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Turf or Unpaved Areas: Plus or minus [1 inch (25 mm)].
   2. Walks: Plus or minus [1 inch (25 mm)].
   3. Pavements: Plus or minus [1/2 inch (13 mm)].

C. Grading inside Building Lines: Finish subgrade to a tolerance of [1/2 inch (13 mm)] when tested with a 10-foot (3-m) straightedge.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.


3.17 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

3.18 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 4000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000
SECTION 312500 – EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Contractor shall be fully responsible for the Storm Water Discharge Permit and fully comply with the Montana Department of Environmental Quality (DEQ) regulations in regards to Storm Water Discharges associated with Construction Activity including, but not limited to, any and all submittals, inspections, fees, reporting, training, and installation of Best Management Practices (BMP's). CONTRACTOR shall sign all permits and forms and assumes all responsibility of management of the Storm Water Erosion Control Plan and any associated records or fines.

B. The CONTRACTOR is required to develop a Storm Water Pollution Prevention Plan (SWPPP) per DEQ standards. The SWPPP must clearly address the effluent limitations and the selected BMP’s to be used to manage pollutant sources and ensure appropriate protection of state surface waters as outlined in DEQ's General Permit for Storm Water Discharges Associated with Construction Activity (called “General Permit”). In case of conflict between this specification and the General Permit, the General permit shall prevail.

C. The site is required to reach "final stabilization" before permit coverage may be terminated. In Montana's semi-arid climate, the time necessary to achieve this "final stabilization" often requires maintenance and permit coverage well beyond the Substantial Completion phase to ensure vegetation or other site stabilization measures are in-place.

1.2 RELATED REQUIREMENTS:

A. Section 31 1000 - Site Clearing.

B. Section 31 2000 - Earth Moving.
1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:


2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.

3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 DEFINITIONS

A. Best Management Practices (BMPs)

1. Schedule of activities, prohibition of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of state surface waters. BMP’s also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

B. Final stabilization

1. The time at which all soil-disturbing activities at the site have been completed, and a vegetative cover has been established with a density of at least 70% of the pre-disturbance levels, or equivalent permanent, physical erosion reduction methods have been employed. Final stabilization using vegetation must be accomplished using seeding mixtures or forbs, grasses, and shrubs that are adapted to the conditions of the site. Establishment of a vegetative cover capable of providing erosion control equivalent to pre-existing conditions at the site will be considered final stabilization.

1.5 SUBMITTALS

A. Prior to receiving a Notice to Proceed, contractor shall submit to the ENGINEER the following documentation:
1. a copy of the completed and signed NOI form;

2. a copy of the signed SWPPP as submitted to the DEQ; and

3. a copy of the Department's Confirmation Letter for receipt of the complete NOI Package.

B. In addition, the ENGINEER shall be copied on all documentation submitted to or received from the MT DEQ including but not limited to notices of noncompliance, if necessary and the Notice of Termination, when submitted.

1.6 APPLICABLE LAWS AND REGULATIONS

1.7 Per ARM 17.30.1105, CONTRACTOR shall obtain permit coverage under the General Permit for Storm Water Discharges Associated with Construction Activity (General Permit). A copy of this permit is included at the end of this section.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. Permit coverage can be obtained by the DEQ's Water Protection Bureau after receiving the following Notice of Intent (NOI) Package items by the proposed construction start date:

B. NOI form with all requested items completed. A draft copy of this form is included in the Appendix and intended as a starting point for development of the NOI. Technical data available to the ENGINEER has been included in this draft permit for the CONTRACTOR's convenience.

C. Storm Water Pollution Prevention Plan (SWPPP) addressing all requested items in the General Permit. A draft copy of the form created by the DEQ to satisfy this requirement is included in the Appendix and intended as a starting point for development of the SWPPP. Additional guidance to completing a SWPPP can be found in the General Permit and on the MT DEQ website. Technical data available to the ENGINEER has been included in this draft permit for the CONTRACTOR's convenience.

D. Application fee based on the total acres of disturbed land.
E. CONTRACTOR must read and be familiar with the General Permit to assist in the completion of the forms and submittal of the NOI Package. Note that formal signatory requirements allow only certain qualified people to sign NOI forms and other forms or reports.

F. The CONTRACTOR will be responsible for annual renewals of the permit until “final stabilization” has occurred and the Notice of Termination (NOT) can be submitted. The CONTRACTOR must submit a NOT form when the construction activity is complete and the site has achieved “final stabilization.” ENGINEER shall be notified of any inspection made for the purpose of determining if the site has achieved final stabilization.

G. SWPPP Administrator

1. Per DEQ regulations, the CONTRACTOR must specify a Primary SWPPP Administrator(s), a Secondary SWPPP Administrator (as applicable), and any other designated SWPPP Administrator(s) in the SWPPP. A SWPPP Administrator(s) is an individual or position title who is responsible for developing, implementing, maintaining, revising, and updating the SWPPP. The SWPPP Administrator(s) must address all aspects of the SWPPP, initiating with the start of construction activities, and lasting until final stabilization is achieved and the permit authorization is terminated. There can be multiple individuals and/or position titles which serve as a SWPPP Administrator; but a Primary SWPPP Administrator and Secondary SWPPP Administrator (as applicable) must be identified on the NOI Form and in the SWPPP.

2. The SWPPP Administrator(s) must have knowledge of the principles and practices of erosion and sediment controls and pollution prevention practices and possess the skills necessary to assess site conditions and determine the effectiveness of selected BMPs.

3. The SWPPP Administrator(s) must meet the authorized representative requirements as defined in Part 4.15 of the General Permit to sign inspection reports and other reports. The primary and secondary SWPPP Administrators identified in Section F of the Form NOI must meet this requirement. The SWPPP Administrator(s) must be trained as required in the General Permit.

3.2 Inspections

A. Inspections must be performed by a SWPPP Administrator. Site inspections are to be conducted according to section 2.3.4 of the General Permit. Site inspections are to be conducted during the construction project's normal working hours and the inspection schedule must be documented in the SWPPP. Site inspections must be performed in accordance with one of the two schedules listed Parts 2.3.1. or 2.3.2. of the General Permit unless subject to the schedule in Part 2.3.3. The initial SWPPP submitted with the NOI Package must specify which inspection schedule will be utilized (either Part 2.3.1. or 2.3.2.), and this inspection schedule must be used until final stabilization is achieved for all areas of the construction activity, except for any temporary reduced inspection schedule as allowed in Part 2.3.3. The CONTRACTOR cannot switch between the inspection schedule options in Parts 2.3.1. and 2.3.2. during the life of the permit authorization.
3.3 Maintenance

A. All BMPs identified in the SWPPP must be maintained in effective operating condition. If site inspections identify BMPs which are not in effective operating condition, maintenance must be performed before the next storm event. If existing BMPs need to be modified, or if additional BMPs are necessary for any reason, implementation of these additional measures must be completed before the next storm event. All changes in the design, implementation, or installation of erosion and sediment control or other BMPs must be documented where applicable in the SWPPP. SWPPP changes must also be summarized in a SWPPP Revision/Update Log as required in Part 3.12.2. of the General Permit. Prior to submitting a Notice of Termination, all temporary BMP's should be removed.

3.4 Recordkeeping

A. At the identified site, the primary SWPPP Administrator must retain all documentation required in the General permit including but not limited to:

1. a copy of the General Permit;

2. a copy of the completed and signed NOI form;

3. a copy of the Department's Confirmation Letter for receipt of the complete NOI Package

4. a copy of the latest up-to-date and signed SWPPP;

5. BMP installation and design standards for all BMPs installed and detailed in the SWPPP;

6. SWPPP Administrator(s) documentation under Part 3.2. of the General Permit;

7. SWPPP Administrator Delegation Form (if applicable);

8. SWPPP Revision/Update Log as required under Part 3.12.2. of the General Permit;

9. all inspection records required under Part 2.3. of the General Permit; and

10. all reports of noncompliance under Part 4 of this permit.
11. These documents are to be made available at the site immediately upon request from the ENGINEER, OWNER, a Department representative, EPA official, or local official.

3.5 END OF SECTION 312500
SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cold milling of existing asphalt pavement.
   2. Hot-mix asphalt patching.
   3. Hot-mix asphalt paving.
   4. Hot-mix asphalt overlay.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
   2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:
   2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
   3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
      a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.
B. Material Test Reports: For each paving material, by a qualified testing agency.
C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.
B. Aggregate shall meet Type B requirements of the Montana Public Works Standard Specifications, sixth edition (MPWSS).

2.2 ASPHALT MATERIALS

B. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Water: Potable.

2.3 AUXILIARY MATERIALS


2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes; designed according to procedures in Al MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:


PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new subgrade.

B. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
C. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

3.4 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.

2. Place hot mix in compliance with Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Density: 92 percent of reference maximum theoretical density according to ASTM D 2041

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   
   1. Base Course: Plus or minus 1/2 inch (13 mm).
   2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
   
   1. Surface Course: 1/8 inch (3 mm).
   2. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.
   
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
      
      a. Two tests will be taken for every 4000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216
SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

1.2 RELATED REQUIREMENTS:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than detectable warnings.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
4. Section 31200 Earth Moving

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:

2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.

D. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

E. Pre-installation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

   1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.


D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420); deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

I. Deformed-Steel Wire: ASTM A 496/A 496M.

J. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

K. Hook Bolts: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

L. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

M. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

N. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, gray portland cement Type I.

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (25 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.


E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, [1/2 to 1-1/2 inches (13 to 38 mm)] long.

B. Fiber reinforcement required in all exterior Portland cement sidewalks and paving.

2.5 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

B. Water: Potable.

C. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
E. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

E. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m).

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M[ and ASTM C 1116/C 1116M]. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 50 feet (15.25 m) unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
   1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 degree F (4.4 degree C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degree F (10 degree C) and not more than 80 degree F (27 degree C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

M. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 degree F (32 degree C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch (1.6 to 3 mm) deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.
C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound as follows:

1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unlevelled straightedge not to exceed 1/2 inch (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 25 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313
SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Cold-applied, jet-fuel-resistant joint sealants.
3. Hot-applied joint sealants.

1.2 RELATED REQUIREMENTS:

1. Section 321216 "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
2. Section 321313 "Concrete Paving" for constructing joints in concrete pavement.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:

2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint seals in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Pavement-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer [testing agency].
B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.
C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for joint sealants.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

1.7 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer [or are below 40 degrees F (5 degrees C)].
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS


2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of joint-sealant backings.
   2. Do not stretch, twist, puncture, or tear joint-sealant backings.
   3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place joint sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   1. Remove excess joint sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

A. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.
END OF SECTION 321373
SECTION 32 17 23 - PAVEMENT MARKINGS

1.1 GENERAL SUMMARY
   A. Section includes painted markings applied to asphalt and concrete pavement.

1.2 RELATED REQUIREMENTS:
   1. Section 321216 Asphalt Paving
   2. Section 321313 Concrete Paving

1.3 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Standard Specifications:
      2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
      3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include technical data and tested physical and performance properties.

1.5 FIELD CONDITIONS
   A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of [40 degrees F (4.4 degrees C) for alkyd materials] [55 degrees F (12.8 degrees C) for water-based materials], and not exceeding 95 degrees F (35 degrees C).
PART 2 - PRODUCTS

2.1 Products to comply with Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

2.2 PAVEMENT-MARKING PAINT
   A. To comply with Montana Public Works Standard Specifications, sixth edition (MPWSS), as amended by City of Bozeman Modifications to MPWSS, latest edition.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
   B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING
   A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
   B. Sweep and clean surface to eliminate loose material and dust.

3.3 PROTECTING AND CLEANING
   A. Protect pavement markings from damage and wear during remainder of construction period.
   B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723
SECTION 331000 - WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes water-distribution piping and related components outside the building for combined water service and fire-service mains.

1.2 RELATED REQUIREMENTS:
   A. Section 31 1000 - Site Clearing.
   B. Section 31 2000 - Earth Moving.

1.3 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   B. Standard Specifications:
      2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
      3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 DEFINITIONS
   A. DI Ductile Iron
   B. PE: Polyethylene plastic.
   C. PP: Polypropylene plastic.
   D. PVC: Polyvinyl chloride plastic.

1.5 ACTION SUBMITTALS
   A. Product Data: For each type of product, pipe, fitting and miscellaneous fitting indicated.
1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.


D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Architect no fewer than two 2 days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Architect's written permission.

1.11 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 WATER MAINS, SERVICES, VALVES AND FITTINGS


2.2 CORROSION-PROTECTION PIPING ENCASEMENT


2.3 FIRE HYDRANTS


PART 3 - EXECUTION

3.1 GENERAL

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

END OF SECTION 331000
SECTION 333000 - SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes waste water-collection piping and related components outside the building.

1.2 RELATED REQUIREMENTS:

A. Section 31 1000 - Site Clearing.
B. Section 31 2000 - Earth Moving.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Standard Specifications:
   2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
   3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, pipe, fitting and miscellaneous fitting indicated.
B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

2. Comply with standards of authorities having jurisdiction for waste water-service piping, including materials, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer’s written rigging instructions.

PART 2 - PRODUCTS

2.1 MAINS, MANHOLES, CLEANOUTS, FRAMES, COVERS AND FITTINGS


PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 “Earth Moving.”

3.2 PIPING INSTALLATION


3.3 MANHOLE AND CLEANOUT INSTALLATION


3.4 FIELD QUALITY CONTROL

3.5 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 333000
SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pipe and fittings.
   2. Manholes.
   3. Catch basins.
   4. Stormwater inlets.
   5. Stormwater detention structures.
   6. Pipe outlets.
   7. Oils sand separators

1.2 RELATED REQUIREMENTS:

A. Section 31 1000 - Site Clearing.
B. Section 31 2000 - Earth Moving.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Standard Specifications:
   2. Except as specifically noted otherwise in the contract documents, all work shall be performed in accordance with the Standard Specifications.
   3. The information in these project specifications shall take precedence in the event of any discrepancies. Any discrepancies discovered by the Contractor shall be brought to the attention of the Engineer before performing the associated work.

1.4 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.
B. RCP: Reinforced concrete pipe.
C. CMP: corrugated metal pipe
1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
   1. Manholes: Include plans, elevations, sections, details, frames, and covers.
   2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
   3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle manholes, catch basins and stormwater inlets according to manufacturer’s written rigging instructions.

PART 2 - PRODUCTS

2.1 PIPE, MANHOLES, CATCHBASINS, INLETS, OIL SAND SEPARATORS AND MISCELLANOUS FITTINGS


PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

3.3 FIELD QUALITY CONTROL


3.4 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100
SECTION 316310 – VERTICALLY RAMMED ENGINEERED AGGREGATE PIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes all equipment, material, labor, and supervision for the design, installation, and testing of the drilled/replacement, vertically rammed engineered aggregate pier (EAP) ground improvement system. The EAP system must meet the performance requirements specified in this specification and the construction documents and shall rely on subsurface information presented in the project geotechnical report.

B. Work in other Sections related to Engineered Aggregate Piers:

1. Division 31 Section “Site Clearing.”
2. Division 31 Section “Earth Moving.”

1.2 DESCRIPTION OF EAP SYSTEM

A. The EAP system shall be constructed by vertically ramming (compacting, with no vibration) aggregate in an excavated or drilled shaft using special high-energy impact ramming equipment. The aggregate pier elements shall be in a columnar configuration and shall be used to reinforce soils for the support of slabs and high bearing pressure footings.

B. Special high-energy impact ramming apparatus shall be used to produce the EAP ground improvement system. The ramming assembly shall include a 2,500 lb. class hydraulic break hammer, equivalent or greater, with a patented beveled rammer.

1.3 REFERENCE STANDARDS

A. Design:


B. Modulus and Uplift Testing

C. Materials and Inspection
   2. ASTM STP 399 (1966)- Dynamic Cone Penetrometer Testing
   4. ASTM D 698 - Standard Proctor Test/Aggregate Densification

D. Conflicts between Specifications and References
   1. Where specifications and reference documents conflict, the Project Structural Engineer of Record/Project Geotechnical Engineer shall make the final determination of the applicable document.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. EAP Designer Submittals:
   1. Submit detailed design calculations, subgrade/ground improvement construction drawings, material specifications and shop drawings, (the Design Submittal), to the Structural Engineer of Record and Project Geotechnical Engineer for review and approval at least 3 weeks prior to the beginning of construction. All EAP system design calculations and plans shall be prepared and sealed by a Professional Engineer licensed in the state of Montana. The design submittal shall consider the following:
      a. Design Considerations:
         1) The design submitted by the EAP Designer shall consider the actual service load bearing pressure and settlement of all foundations in the building, including spread footings, shearwall and retaining wall footings, and strip wall footings, and shall be in accordance with acceptable engineering practice and these specifications.
         2) The design life of the installed EAP system shall be no less than 75 years.
         3) The EAP system shall be designed to preclude significant plastic bulging deformations at the top-of–pier design stress and in the absence of tip termination upon a bearing stratum (stiff or medium dense soil) to preclude significant tip stresses as determined from end-bearing capacity analysis or the shape of the telltale test curve from telltales installed in modulus test piers. The results of the modulus test shall be used to verify the design assumptions.
         4) EAP system shall be designed in accordance with the reference design standards in Section 1.3. EAP system design shall meet the following performance criteria:
            a) Allowable service level dead load plus live load bearing pressure for footings supported by EAP reinforced subgrade shall be 5,500 psf.
            b) Estimated total long-term settlement for footings: shall be less than or equal to 1.0-inch.
            c) Estimated long-term differential settlement of adjacent footings shall be less than or equal to ½-inch.
            d) Coefficient of sliding friction applied as a uniform value across the footing bottom in contact with the EAP improved subgrade shall be a minimum of 0.45.
C. EAP Installer Submittals:

1. Modulus Test Requirements – A load test schedule shall be prepared by the Installer for each modulus test (based on the project requirements and in accordance with Section 3.4 of these specifications. Each proposed load test location shall be shown on the shop drawings, and must be approved by the Project Geotechnical Engineer and Project Structural Engineer of Record. The intent is to locate the load tests at locations where the most settlement and/or design load is anticipated. A report of load testing results shall be submitted to the Owner and Project Geotechnical Engineer after completion of the load tests. The report shall include a description of the installation equipment, installation records and complete test data; analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared by or under the direct supervision of a registered professional engineer experienced in modulus testing, performance and analysis of the aggregate pier system.

2. Aggregate Material delivery tickets from the aggregate supplier shall be obtained by the EAP installer to verify that it has the appropriate rating and gradation. Approval of alternate materials shall be obtained from the Pier Designer.

3. Minutes of EAP pre-installation conference.

4. Daily EAP Installation Reports – Aggregate Pier Progress Report shall be completed by the installer during each day of installation, and shall consist of the following: Date of installation and summary of installation equipment and installation procedures; Pier location, length, and diameter; Final elevations of the pier top and bottom; Documentation of any unusual subsurface conditions encountered; Soil and groundwater observations, if any; The results of any field Quality Control testing or deflection monitoring done. The Installer shall immediately report any unusual conditions encountered during installation to the EAP Designer, to the Owner’s Testing Agency, and the Project Geotechnical Engineer.

5. EAP System Record Drawings - The Installer shall furnish Record Drawings specifying the location of the installed EAPs to the Project Structural Engineer of Record, and Project Geotechnical Engineer. The record shall indicate the constructed pier location, length, average lift depth, final elevations of the base and top of piers, and the type and size of the densification equipment used. The record shall also include select graphs of the rammer deflection data and or calibrated dynamic penetration test (ASTM STP 399) data for the piers constructed.

D. Project Geotechnical Engineer Observation Report

1. EAP Installation: A signed and sealed written observation report shall be provided by the Project Geotechnical Engineer to the General contractor, to the EAP System
2. Spread Foundation Construction: The Project Geotechnical Engineer shall prepare a report documenting the spread foundation construction, including verification of EAP elements required for each foundation and preparation of the foundation bottom as specified in these specifications and construction documents.


1.5 QUALITY ASSURANCE

A. EAP System Installer Qualifications: An experienced installer who has completed work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance. They shall have a minimum of 5 years of experience with the installation of EAP and shall have completed at least 25 projects of similar or larger size and scope. The Installer shall adhere to all requirements described in this Specification.

B. EAP System Designer Qualifications: EAP System Designer (Designer) shall have demonstrated experience in the design of similar size and types of projects and shall have a minimum of 5 years of experience EAP System design and shall have completed at least 25 projects of similar or larger size and scope. The Designer shall be a professional engineer who is legally qualified to practice in Montana.

C. The EAP Designer, Installer, shall have a pre-installation meeting at the site to include the General Contractor, Geotechnical Engineer and Testing Agency personnel and prepare and distribute meeting minutes in accordance with Division 1 Specification - "Administrative Requirements".

D. The Installer shall have a full-time Quality Control (QC) representative to verify and report all QC installation procedures. The Installer shall immediately report any unusual conditions encountered during installation, to the EAP System Designer, to the Owner’s Testing Agency, and the Project Geotechnical Engineer.

E. The Owner is responsible for retaining an independent engineering testing firm to provide Quality Assurance (QA) services. The Testing Agency shall observe the modulus and uplift test(s) when modulus or uplift test(s) are to be performed. The Installer shall set up and conduct the test(s) and provide and install all dial indicators and other measuring devices. The Testing Agency shall observe the installation of EAP test elements.

F. The EAP System Designer or a qualified representative shall perform sufficient site visits as to observe excavation and installation of the EAPs. A qualified Designer representative consists of an individual with at least 2 years of construction/design experience.

PART 2 - PRODUCTS
2.1 AGGREGATE

A. Material used to form the EAP elements shall be hard and chemically inert so as to remain stable during column construction and building service life in the anticipated soil and ground water conditions. The aggregate shall consist of solid, durable, and non-friable rock; free of thin, slab-type rock fragments and conform to standards used by the EAP industry.

B. Material shall be used with a grading appropriate for compaction to form a dense column.

C. The material used to build the EAP elements shall be as specified by the EAP System Designer. The EAP System Designer shall be notified for approval, prior to use, when changes in specification or supply of the material is encountered.

PART 3 - EXECUTION

3.1 GENERAL

A. EAP system installation shall be performed following rough grading of the project site or building pad.

B. General Contractor to locate and protect underground and aboveground utilities and other structures from damage during installation of the EAP elements.

C. A working surface shall be established as needed by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the EAP system installation.

D. Ponding of water in the area of footing excavation shall not be permitted. General Contractor and EAP installer to coordinate to maintain a level, well drained surface.

E. If cave-ins occur during excavation such that the sidewalls of the shaft are deemed to be unstable, a temporary steel casing shall be used to stabilize the excavation.

F. If cave-ins occur on top of a lift of aggregate such that the volume of the caved soils is greater than 15 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.

G. After drilling of the shaft, to form the bottom bulb the rammer energy shall be applied on the first lift of aggregate in wet conditions or to the in-situ soil in dry conditions. After construction of the bottom bulb, aggregate shall be rammed in thin lifts in the shaft to the planned top elevation as shown in the drawings and/or quality control records. Aggregate shall be placed in the augered cavity in compacted lift thicknesses no greater than 24 inches or as determined by the EAP System Designer.

H. A specially-designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The tamper diameter shall be at least 80% of the pre-augered hole diameter. The apparatus shall apply direct downward impact energy to each lift of aggregate.
3.2 LOCATING EAP ELEMENTS

A. The center of each pier element shall be within six inches of the plan locations indicated or specifically approved by the pier installer. The final measurement of the top of piers shall be the lowest point on the aggregate in the last rammed lift.

B. Ground elevations at each staked EAP location shall be provided in sufficient detail to estimate drilling depth elevations to within 2 inches. These shall be provided on stakes at each pier location and by data export a minimum of 1 day prior to pier installation in a given area.

C. EAP elements installed outside of the above tolerances and deemed not acceptable, except as caused by obstructions or Changed Conditions, shall be rebuilt at no additional expense to the General Contractor or Owner.

3.3 OBSTRUCTIONS

A. Should any obstruction be encountered during drilling or excavation for EAPs, the General Contractor shall be responsible for removing such obstruction, or the pier shall be relocated or abandoned as approved by the Owner's Representative. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, debris, utility lines, etc., that prevent installing the EAPs to the required depth, or cause the aggregate pier to drift from the required locations.

B. EAP elements may be terminated short of design depths on top of partially weathered rock, or very dense gravel layers as approved by the Project Geotechnical Engineer of Record.

3.4 FIELD TESTING AND INSPECTIONS

A. The Installer shall have a full-time Quality Control representative (QCR) to report installation procedures. The QCR may be a member of the installation crew. The QCR shall immediately report any unusual conditions encountered during installation to the EAP System Design Engineer, the General Contractor, and to the Testing Agency. The quality control procedures shall include the preparation of EAP Progress Reports completed during each day of installation and containing the following:
   1. EAP location;
   2. EAP length and drilled diameter;
   3. Planned and actual pier elevations at the top and bottom of EAP element;
   4. Average lift thickness for each EAP element;
   5. Depth of groundwater, if encountered;
   6. Documentation of any unusual conditions encountered; and
   7. Type and size of ramming equipment used.

B. The Owner shall retain an independent engineering testing firm to provide Quality Assurance (QA) services. This Testing Agency shall observe the modulus and uplift test(s) when modulus or uplift test(s) are to be performed. The Installer shall set up and conduct the test(s) and provide and install all dial indicators and other measuring devices. The Testing Agency shall observe the installation of EAP elements.

C. Prior to installing production piers, the aggregate pier designer shall establish the required energy output for the rammer and terminal rammer-blow deflection criterion for the ramming of each lift. Rammer energy output shall be confirmed by the installer prior to construction of
production piers. Instrumentation used to confirm rammer-blow deflections shall be capable of recording to a precision of at least 0.001 inch per rammer stroke, and shall be capable of recording deflection accompanying each rammer blow. During pier lift construction, rammer-blow deflections shall be monitored in at least 5% of the piers for the project to confirm that the design deflection per rammer-blow is achieved. Rammer-blow deflection monitoring shall be performed randomly on installed piers to confirm that terminal rammer-blow deflections meet the established acceptance criterion.

D. EAP Modulus Load Testing

1. A minimum of one modulus test shall be performed to verify the parameter values selected for design. The test(s) shall be performed by the EAP installer at locations agreed upon by the EAP System Designer, Project Structural Engineer of Record, Project Geotechnical Engineer and the Owner's Testing Agency. EAP modulus testing shall be performed in accordance with the requirements outlined in the EAP Design Submittal. At a minimum, the modulus testing shall include the following:
   a. EAP elements shall be tested to 150% of the maximum design stress as shown in the EAP System design submittal. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143, ASTM D 1194 and ASTM D 3689, as outlined below. The modulus tests shall be of the type and installed in a manner specified herein.
   b. The Modulus test shall be performed in and on the neat drilled diameter only, no exceptions, i.e. a footing area is not acceptable.
   c. Unless terminating upon a bearing layer as verified by testing agency, a –telltale shall be installed at the bottom of the test pier so that bottom-of-pier deflections may be determined. Acceptable performance is indicated when the bottom of the pier deflection is no more than 20% of the top of pier deflection at the design stress level.
   d. ASTM D-1143 general test procedures shall be used as a guide to establishing load increments, load increment duration, and load decrements.
   e. With the exception of the load increment representing approximately 115% of the design maximum EAP stress, all load increments shall be held for a minimum of 15 minutes, a maximum of 2 hours, and until the rate of deflection reduces to 0.01 inch per hour, or less.
   f. The load increment that represents approximately 115% of the design maximum stress on the EAP shall be held for a minimum of 15 minutes. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 4 hours, whichever is occurs first
   g. A seating load equal to 5 percent of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance.

2. The results of the modulus load test shall be reported on a deflection versus stress graph. The EAP modulus shall be calculated as the design stress divided by the deflection of the top plate minus the deflection of the bottom plate at the design stress. The deflection of the top and bottom plates shall not exceed the upper zone settlement as shown in the design calculations.

3. Based on the load tests, if performance criteria specified in this specification and on construction drawings is not met, the installer shall either modify the design and/or installation to meet the performance criteria or retest to prove compliance with performance criteria at no additional charge unless the unacceptable performance is due to a change-of-condition from those revealed in the geotechnical site characterization.
3.5 FOOTING AND UTILITY EXCAVATIONS

A. Coordinate all excavations made subsequent to EAP installations so that the integrity of the EAPs are not compromised. Confirm safe excavation distances/depths with the Installer and EAP System Designer. Protect completed EAP elements during foundation preparation per Details provided in the EAP Design Drawings.

B. Footing excavation must be performed with a smooth-edged bucket (no teeth) to limit disturbance of the tops of piers at bearing elevation. Over-excavation below the bottom of the footing may be allowed, with replacement per Details provided in the EAP Design Drawings.

C. Typical installation sequencing will consist of installing the EAP from the rough graded or native ground surface above the footing subgrade elevations. The pier tops will be extended to elevations approximately 12 inches above footing subgrade. The remainder of the pier excavation will be backfilled with overburden to protect the top of piers until the footing excavation is completed. The overburden will then be excavated down to the footing subgrade using a smoothed edged excavator bucket to limit disturbance to the tops of the piers and footing subgrade. If excavation is conducted properly in a good workmanship manner the final footing subgrade with top of piers exposed should consist of a smooth level unyielding surface.

D. Before footing construction, the tops of all the EAP elements exposed in each footing excavation shall be inspected by the Geotechnical Engineer and Testing Agency. The tops of any pier elements that may have been disturbed by footing excavation and related activity shall be recompacted to a dry density equivalent to at least 98% of the maximum dry density obtainable by the modified AASHTO compaction procedure (ASTM D 698). Mechanical tamping type compactors (not vibratory) shall be used to re-compact the pier tops as necessary to meet the requirements of the EAP design, and the requirements of the construction documents.

E. Inspect all foundations and remove all loose soil or mud and properly prepare foundation subgrade as directed by the Owner’s testing agency prior to concrete placement.

F. Foundation excavations to expose the tops of EAP elements shall be made in a workmanlike manner, and shall be protected until concrete placement, with procedures and equipment best suited to:
   1. Prevent softening of the matrix soil between and around the EAP elements before pouring structural concrete, i.e. water shall not be allowed to pond in footing excavations or around tops of piers.
   2. Achieve direct and firm contact between the dense, undisturbed EAP elements (or properly placed structural fill per EAP Design Details) and the concrete foundations.

G. If same day placement of foundation concrete is not possible, the Contractor shall consider the placement of a minimum 3-inch thick lean concrete seal ("mud mat") immediately after the foundation bottom is excavated and approved.

H. EAP elements designed for each footing shall be exposed at the completion of footing excavation.

I. For the purpose of this specification, the zone of influence is an envelope defined by a horizontal distance of 5 feet from the EAP edge then extending down 5 feet to a point that intersects an imaginary 1:1 sloping plane from the top of the EAP element. The zone of influence continues along the 1:1 slope to a point that corresponds to the bottom of the EAP element elevation.
J. In the event that utility excavations are required within the zone of influence, the General Contractor shall contact the EAP Designer to develop construction solutions to minimize impacts on the installed EAP.

END OF SECTION 316310
June 18, 2015
Q:\22\11447-01\40Study\Geotechnical\Parking Garage\MSU NAIC Parking Garage GI RPT.docx

Mr. Dusty Eaton, AIA, LEED AP, Principal
608 N. 29th St.
Billings, MT 59701

RE: MSU Parking Garage Geotechnical Report
Proposed Norm Asbjornson Innovation Center
Montana State University – Bozeman, MT

Dear Mr. Eaton:

We are pleased to present this final geotechnical report for the proposed parking garage at the Norm Asbjornson Innovation Center located at Montana State University in Bozeman, Montana. The enclosed report describes site conditions and presents conclusions and recommendations for design and planning of the parking garage. We are available to answer any questions that may come up as the design progresses.

Please contact DOWL HKM if you have any questions in regard to this report.

Respectfully submitted,

DOWL HKM

[Signature]

Gregory Underhill, P.E.
Senior Geotechnical Engineer
GEOTECHNICAL REPORT

PARKING GARAGE
AT PROPOSED NORM ASBJORNSON INNOVATION CENTER
MONTANA STATE UNIVERSITY
BOZEMAN, MONTANA

Prepared for:

A&E ARCHITECTS

Mr. Dusty Eaton, AIA, LEED AP, Principal
608 N. 29th St.
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Prepared by:

DOWL HKM

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Author: Greg Underhill, P.E.
Review: Steve Weisenberger, P.E.

June 18, 2015
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APPENDICES

Appendix A  Boring Logs
Appendix B  Laboratory Test Results
Appendix C  Photographs
Appendix D  Screw Pile Information
1.0 SUMMARY

DOWL HKM has completed the geotechnical investigation for the proposed parking garage to be constructed in conjunction with the proposed new Norm Asbjornson Innovation Center (NAIC) at the Montana State University Bozeman, Montana (Figure 1). A preliminary geotechnical evaluation was conducted in November, 2014 which consisted of advancement four exploration borings (B-1 through B-4) and Preliminary Geotechnical Report dated January 13, 2015. This investigation consisted of advancement of four additional borings (B-5 through B-8) located within the footprint of the proposed parking garage structure. All boring locations are shown on Figure 2.

The parking garage structure will be located within the southwest corner area of the Norm Asbjornson Innovation Center site, primarily within the southern end of the current band practice field as shown in Figure 2.

The soil profiles encountered at the parking garage location were very similar to those observed during the preliminary investigation. The soil profiles consist of topsoil or pavement surfacing overlaying native lean clay deposits that overlay layers of medium to very dense gravel deposits. Medium dense to very dense silty sand and or sandy silt deposits underlay the gravel and transition to siltstone or sandstone bedrock at depth. The siltstone and sandstone deposits are poorly indurated and are considered to be relatively soft or weak in consistency. The siltstone and sandstone deposits extend to the greatest depth drilled.

Groundwater was encountered in all of the borings at depths from 18.5 to 21.4 feet during the time of the investigation.

Based on the preliminary investigation and this investigation which included boring and laboratory testing information, the surficial native clay soils typically exhibit moderate to low bearing strength and high compressibility. Settlements in excess of two (2) inches could occur from heavily loaded footings placed on the native clay soils and the potential for excessive differential settlements is significant. It is therefore recommended to utilize deep foundations to support the new facilities. Foundation support options for drilled piers, driven piling or screw piles as well rammed aggregate pier foundation soil improvement are provided.

It is our opinion that the native clay soils are suitable to support interior slab on-grade floors provided the clay subgrade soils are partially over-excavated from beneath the floor areas and subgrade preparation and structural fill placement is performed as specified under Section 5.2.3.

Recommendations in this report are contingent upon DOWL HKM’s involvement during the planning, design and construction stages of the project. If any unexpected soils or conditions are revealed during construction, this office should be notified immediately to survey the conditions and make necessary modifications.
Figure 1: Vicinity Map
2.0 PLANNED CONSTRUCTION

MSU will be constructing the new Norm Asbjornson Innovation Center which will include a parking garage to be located on the corner of West Grant and South 7th avenue within the current pay parking lot and band practice field immediately east of the Health and PE complex. The parking garage structure will be located within the southwest corner area of the site primarily within the southern end of the current band practice field as shown in Figure 2. The proposed parking garage will consist of a four story, slab-on-grade structure with concrete cast-in-place beam/column moment frame system with post tensioned decks and beams. Building loads and column configurations for the parking garage are preliminary. The following loads have been provided at this time by Walker Parking Consultants:

- Typical Interior: D= 415k, L=170
- Typical Exterior: D= 220k, L=82 k

3.0 INVESTIGATION PROCEDURE

3.1 INVESTIGATIONS

A preliminary geotechnical evaluation was conducted within at the general Norm Asbjornson Innovation Center site during November, 2014. The preliminary investigation consisted of advancement of four geotechnical borings (B-1 through B-4), laboratory testing, preliminary engineering analysis and a Preliminary Geotechnical Report which was submitted on January 13, 2015. This investigation for the proposed parking garage consisted of advancement of four additional borings (B-5 through B-8) within the proposed parking garage footprint, laboratory testing, engineering analysis and recommendations presented in this report. The boring locations are shown on Figure 2. Boring logs and test data obtained during the preliminary investigation are also presented within this report.

3.2 FIELD INVESTIGATION

The field investigation for the parking garage was performed between the dates of May 20 through 23, 2015. The field investigation consisted of a geologic review, site observations and advancement of four (4) soil borings. The borings were advanced utilizing a truck-mounted Mobile B-61 drilling rig equipped with 8 ¼ inch O.D. hollow stem augers. The drilling was performed under the direction of a DOWL HKM Geotechnical Engineer. The locations of the borings are presented in the Geotechnical Investigation Boring Location Site Map (Figure 2). The borings were advanced to depths ranging from approximately 45.2 to 81.5 feet.

Horizontal locations of the borings were determined by measuring from existing building and sidewalk corners. Vertical elevations of the exploration borings were determined by interpolation from topographic map contours.
At each boring location, Standard Penetration Test (SPT) sampling was performed using a 2-inch outside diameter split-spoon sampler in accordance with ASTM D 1586. The tests were performed utilizing an “Automatic Hammer” which simulates driving the sampler into the soil utilizing a series of drops of a 140 lb. weight falling 30 inches for a total penetration of 18 inches into the soil. The number of blows required for each 6 inches of penetration was recorded. The Standard Penetration Resistance (“N-value”) of the soil was then calculated as the number of blows required for the final 12 inches of penetration. If 50 blows were recorded within a single 6-inch interval, the test was terminated and the blow count was recorded as 50 blows for the number of inches of penetration. This resistance, or N-value, provides a measure of the relative density of granular soils and the relative consistency of cohesive soils.

During the drilling, pertinent information including soil sample depths, stratigraphy, soil engineering characteristics and groundwater occurrence were noted. Soil samples were collected while advancing the soil borings using split-spoon sampler. Disturbed bulk samples were obtained from drill cuttings at intervals selected by the field engineer. Relatively undisturbed samples were obtained by hydraulically pushing Shelby tube sample collectors into the subgrade soils. These samples were then transported to the DOWL HKM soils laboratory where engineering property and strength tests were conducted. This information was recorded and is presented on the logs of exploration borings in Appendix A.

The soil descriptions shown on the boring logs are based on field and laboratory testing in accordance with ASTM Standards D 2487 or D 2488. The boring logs contain both factual and interpretive information. On the logs, horizontal lines, designating the interface between differing materials encountered, represent approximate boundaries. The actual transitions may be more gradual or abrupt. The soil and groundwater conditions depicted are only for the specific dates and locations reported, and therefore, are not necessarily representative of other locations and times.

### 3.3 LABORATORY TESTING

Disturbed split-spoon and bulk samples along with relatively undisturbed Shelby tube samples were collected during the field investigation and submitted for testing. Laboratory testing was completed on select soil samples to assist in soil classification and to characterize soil engineering properties. Laboratory testing included the following:
<table>
<thead>
<tr>
<th>Test</th>
<th>Purpose of Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Moisture Content</td>
<td>Provides a measure of natural (in-situ) water content.</td>
</tr>
<tr>
<td>Atterberg Limits</td>
<td>Provides an indicator of the consistency and swell potential of fine grained soils.</td>
</tr>
<tr>
<td>Particle-Size Distribution</td>
<td>Provides a measure of grain sizes of the soils for classification and identification of physical characteristics.</td>
</tr>
<tr>
<td>Moisture-Density Relationship</td>
<td>Provides a measure of the relationship of water content to the density of soil during compaction.</td>
</tr>
<tr>
<td>One dimensional Consolidation</td>
<td>To determine the amount and rate at which a soil will compress when loaded.</td>
</tr>
<tr>
<td>Unconfined Compression</td>
<td>To determine general soil or rock shear strength properties.</td>
</tr>
<tr>
<td>Corrosion Tests (pH, Resistivity, and Sulfates)</td>
<td>To determine the potential for corrosive interaction of soils with concrete and metal</td>
</tr>
</tbody>
</table>
Figure 2: Boring Location Map
4.0 SITE CONDITIONS

4.1 LOCAL GEOLOGIC CONDITIONS

The Gallatin valley is an intermountain basin in the Rocky Mountains bounded by the Bridger and Gallatin Ranges to the East and South. The Gallatin Mountain Range has provided material for vast coalescing alluvial fans deposited upon the valley floor from the South and East valley limits, sloping rather steeply to the North. These alluvial/fluviatile deposits range from Tertiary to Quaternary in age. The project site is located on the MSU campus south of downtown Bozeman which is situated in the southeast extremity of the Gallatin Valley on Quaternary alluvial fan deposits known as the Bozeman Fan. The alluvial fan deposits typically consist of varying thickness depositional clays, sands and gravels. Tertiary age fluviatile and soft bedrock strata underlay the alluvial fan deposits at varying depths and locations.

4.2 SITE DESCRIPTION

A site map is presented in Figure 2. The parking garage site is situated primarily on the grassed band practice field with the eastern edge overlapping onto the student parking lot pavement area. Various buried utilities exist within the site. The topography of the site area is essentially flat sloping gently at an approximate one percent grade to the north. Photographs of the site are presented in Appendix C.

4.3 SOILS

In summary, the soil profiles encountered in borings B-5, through B-8 are relatively consistent and very similar to the conditions reveled in the preliminary exploration borings B-1 through B-4. The soil profiles consist of topsoil or pavement surfacing overlaying native lean clay deposits that overlay layers of medium to very dense gravel deposits. Medium dense to very dense silty sand and or sandy silt deposits underlay the gravel and transition to siltstone or sandstone bedrock at depth. The siltstone and sandstone deposits are poorly indurated and are considered to be relatively soft or weak in consistency. The siltstone and sandstone deposits extend to the greatest depth drilled. Poorly graded sand with widely scattered fine gravel was encountered between the depths of 38.0 to 45.0 feet in boring-7. These deposits transitioned to very weak slightly indurated sandstone at approximately 45 feet in B-7. Additionally, heaving sand conditions were encountered in Boring B-7 between the intervals of 30 to 38 feet and 60 to 75 feet which indicates, that although the deposits exhibited high in-place density, the deposits are sensitive to differential hydrostatic pressure. The sand deposits were cleaner with fewer fines within this interval. Water was not added to the augers during drilling which may have alleviated the heaving sand conditions.

The soil profiles are presented in detail in the exploration boring logs in Appendix A. At the garage location the lean clay deposits extend from the surface to depths ranging from 14.0 (B-5) to 17.5 feet (B-7) feet in depth at which depths gravel was encountered. The gravel layer extends to depths ranging from approximately 21.0 feet (B-5) to 27.0 feet (B-7) at which depths medium dense to dense silty sand/sandy
silt and poorly graded sand (B-7) deposits are encountered. These deposits transition to siltstone or sandstone at depth. The following sections summarize the soils encountered:

4.3.1 Asphalt Surfacing

The asphalt surfacing section at the student parking lot consisted of approximately three (3) inches of asphalt and approximately 12 inches of road base.

4.3.2 Clay

Native lean and or sandy lean clay was encountered near surface in all borings. In general, the clay ranged from soft to stiff in consistency and standard penetration (N) values generally ranged from 7 to 19 blows per foot. Moisture content of the clay ranged from 19.3 to 26.5 percent from depths ranging between 2.5 to 17 feet. Liquid limits and plasticity indices ranged from 34 to 43 percent and 11 to 15 respectively. Results from unconfined compression tests from samples of clay taken at depths of 10 to 12 feet in borings B-6 and B-7 indicate that the clay exhibits unconfined compressive strengths ranging from 1.5 to 1.7 kips per square foot with corresponding undrained shear strengths of .754 to .872 kips per square foot; in place unit dry unit weights of the clay ranged from 86.6 to 93.3 pounds per cubic foot (pcf). These values are slightly lower than values for the clay at boring locations advanced during the preliminary investigation. Results from unconfined compression tests from samples of clay taken at depths of 3, 6 and 16 feet in Borings B-1, B-3 and B-4 respectively indicated that the clay exhibited unconfined compressive strengths ranging from 2.9 to 2.0 kips per square foot with corresponding undrained shear strengths of 1.45 to 1.0 kips per square foot; in place unit dry unit weights of the clay ranged from 98 to 103 pounds per cubic foot (pcf). However, the standard penetration tests taken in Borings B-5 through B-8 were similar or slightly higher than those in Borings B-1 through B-4.

In general, the clay deposits exhibit moderate to low bearing strength, moderate to high compressibility and are generally high in natural moisture.

4.3.3 Gravel

Gravel was encountered in all borings at depths ranging from 14.0 feet (B-5) to 17.5 feet (B-7). The gravel can be generally classified as poorly graded gravel with sand and cobbles. The gravel ranged from dense to very dense in consistency. Standard penetration (N) values ranged from 33 to greater than 84 blows per foot. The gravel was at or below the water table and saturated. The gravel layer thickness ranges from approximately 7 to 9.5 feet and averages approximately 8.6 feet in thickness across the parking garage site based on the borings advanced.

The gravel deposits exhibit high bearing strength and low compressibility.

4.3.4 Silty Sand / Sandy Silt
Silty sand/sandy silt underlays the gravel deposits at all boring locations. These deposits transition between sand and silt at random depth intervals but are predominantly silty sand. The deposits ranged from coarse to fine grained. The deposits extended to depths ranging from 35 feet (B-8) to 45 feet (B-7) at which depths the soils transitioned to sandstone and siltstone. The silty sand and sandy silt ranged from medium dense to dense in consistency. Standard penetration (N) values generally ranged from 18 to 43 blows per foot and averaged 27 blows per foot in the medium dense intervals. Isolated layers of poorly graded sand and fine gravel were encountered within the sand and silt deposits. The sand and silt was below the water table and saturated.

The sand deposits exhibit moderate to high bearing strength and moderate to low compressibility.

4.3.5 Poorly graded sand

Poorly graded sand with widely scattered fine gravel was encountered between the depths of 38.0 to 45.0 feet in boring-7. These deposits transitioned to very weak slightly indurated sandstone at approximately 45 feet in B-7. The deposits ranged from coarse to fine grained. The sand ranged was dense to very dense in consistency. Standard penetration (N) values generally ranged from 54 to 66 blows per foot. This deposit did exhibit sensitivity to differential hydrostatic pressure indicated by heaving sand in the augers during drilling.

The sand deposits exhibit high bearing strength and low compressibility.

4.3.6 Sandstone and Siltstone Bedrock

Sandstone and siltstone bedrock was encountered underlying the sand and silt deposits at depths ranging from 35 to 49.5 feet. In general the bedrock formations are considered moderately indurated or soft rock. It was possible to auger into the formations with some difficulty. Auger refusal was encountered in the sandstone in boring B-3 at a depth of 42 feet. Standard penetration tests ranged from 39 within a “soft layer” to greater than 80 blows per foot. Based on our experience, bedrock undelaying the campus area can be variable in consistency and may contain soft zones.

The bedrock formations generally exhibit high bearing strength and low compressibility.

4.4 GROUNDWATER

Groundwater was encountered in all of the borings at depths from 18.5 to 21.4 feet during the time of the investigation. Table 4-1 presents the approximate depths to the ground water table observed at the time of the investigation. The groundwater generally flows within the gravel layer.
Fluctuations of groundwater occur due to seasonal moisture conditions, irrigation practices, changes in land use, and many other factors. Form our experience groundwater elevations can fluctuate significantly within the MSU campus dependent upon location. Groundwater conditions may vary from those encountered at the time of the field investigation depending upon the influence of these factors. Perched water tables have been encountered at various locations within the MSU campus.

4.5 EARTHQUAKES AND SEISMICITY

The project site is generally within an area of high seismicity. The USGS database presents spectral response acceleration data in bedrock for short (0.2 sec) periods (Ss) and for long (1 sec) periods (S1) for similar probability and 50-year return periods. According to USGS design procedures, this data is then adjusted depending on the soil classification to reflect magnification effects as the earthquake wave energies pass from bedrock into soil. The values are then reduced by a factor that accounts for partial damping of the wave energy by the structure. The final values obtained (known as SDS and SD1) become the basis for the structural design and in this case at the proposed site are estimated at 0.533 g (SDS) and 0.223 g (SD1).

The methods of ASCE/SEI 7-05 require that the properties of the soil at the proposed building site be classified as one of several site classes. The seismic design parameters for this site include a seismic zone soil profile type of (D), in accordance with the above referenced standard. Site Class D corresponds to a stiff soil profile. We have based this classification on the laboratory test data and exploration information.

5.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

Based on the planned construction and soils encountered at the site, the following recommendations are provided at this time.

5.1 GENERAL

The proposed parking garage will consist of a four story, slab on grade structure with concrete cast-in-
place beam/column moment frame system with post tensioned decks and beams. Building loads and column configurations for the parking garage are preliminary. The following loads have been provided at this time by Walker Parking Consultants:

- Typical Interior: D= 415k, L=170
- Typical Exterior: D= 220k, L=82 k
- 

Of consideration is that an interior access ramp will consist of a triangular structural gravel fill ranging from first floor slab elevation 0 to 12 feet in height. The fill will be supported by retaining walls on each side.

Engineering considerations associated with design and construction of the proposed facilities will include foundation options to support column and wall loads, surface drainage and site earthwork. Recommendations for these topics are presented in detail in the following sections.

5.2 FOUNDATIONS

5.2.1 Foundation Options/Recommendations

As discussed previously, the near surface soils at the site consist of native lean clay deposits. Based on the investigation, boring and laboratory testing information, the surficial native clay soils typically exhibit moderate to low bearing strength and high compressibility. Settlements in excess of two (2) inches could occur from heavily loaded footings placed on the native clay soils and the potential for excessive differential settlements is significant. It is therefore recommended to utilize deep foundations or soil improvement methods to support the new facilities. Options for rammed aggregate piers, drilled piers, driven piling or screw piles are provided.

It is our opinion that the native clay soils are suitable to support interior slab on-grade floors provided the clay subgrade soils are partially over-excavated from beneath the floor areas and subgrade preparation and structural fill placement is performed as specified under Section 5.2.3.

As discussed previously an approximate eight (8) foot thick dense gravel layer is encountered at depths of 15 to approximately 18 feet. This gravel layer overlays medium dense to dense silty sand and/or sandy silt. Weak bedrock is encountered at depths ranging from 35 to 45 feet. Groundwater is encountered at approximately 18.5 feet. Given the potentially heavy column and footing loads, it is recommended that the deep foundations bear within the bedrock deposits below the gravel layer or soil improvement methods (RAP) are utilized for the upper clay layer. Table 5-1 presents the approximate depth to the gravel layer at borings advanced within the garage footprint area. It is noted that the elevation of the gravel layer is relatively uniform across the parking garage site. Table 5-2 presents the approximate depth to the bedrock bearing layer. It is noted the elevation of the weak bedrock varies by approximately 8 feet.
### Table 5-1
**Approximate Depth to Gravel Layer**

<table>
<thead>
<tr>
<th>Boring</th>
<th>Surface Elevation</th>
<th>Depth to Gravel Layer (ft)</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>4924.6</td>
<td>15.8</td>
<td>4908.8</td>
</tr>
<tr>
<td>B-5</td>
<td>4921.2</td>
<td>14.0</td>
<td>4907.2</td>
</tr>
<tr>
<td>B-6</td>
<td>4922.3</td>
<td>16.2</td>
<td>4906.9</td>
</tr>
<tr>
<td>B-7</td>
<td>4925.4</td>
<td>17.5</td>
<td>4907.9</td>
</tr>
<tr>
<td>B-8</td>
<td>4923.4</td>
<td>15.0</td>
<td>4908.4</td>
</tr>
</tbody>
</table>

### Table 5-2
**Approximate Depth to Weak Bedrock**

<table>
<thead>
<tr>
<th>Boring</th>
<th>Surface Elevation</th>
<th>Depth to Bedrock (ft)</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>4924.6</td>
<td>43.0</td>
<td>4881.6</td>
</tr>
<tr>
<td>B-5</td>
<td>4921.2</td>
<td>45.0</td>
<td>4881.2</td>
</tr>
<tr>
<td>B-6</td>
<td>4922.3</td>
<td>43.5</td>
<td>4878.8</td>
</tr>
<tr>
<td>B-7</td>
<td>4925.4</td>
<td>45.0</td>
<td>4880.4</td>
</tr>
<tr>
<td>B-8</td>
<td>4923.4</td>
<td>35.0</td>
<td>4888.4</td>
</tr>
</tbody>
</table>

All exterior foundation walls should be placed at a minimum depth of 3.5 feet below final exterior grade for frost protection.

**Preparation of construction working surface:** After the topsoil and pavement fills are excavated to the first floor slab elevation, lean clay subgrade soil will be exposed during construction of the foundation elements. The lean clay is moisture sensitive and will become soft and unstable during wet weather periods. Excessive disturbance of the clay subgrade during wet weather will compromise the subgrade in areas where concrete slabs are to be installed and subsequently require additional over-excavation and replacement of unstable soils. The Contractor should be made aware of this potential and schedule his operations accordingly or construct a suitable wet weather platform (placement of gravel and or stabilization fabric) so as not to compromise the clay subgrade during construction.

### 5.2.1 Rammed Aggregate Piers

The structure could be supported by rammed aggregate piers (RAP). The piers are constructed by augering 24- to 36-inch diameter holes to typical depths of ranging from 8 to 25 feet below the base of the footings and backfilling the excavations with thin lifts of compacted (rammed) aggregate. Compaction densifies the aggregate and increases lateral stress in the soil matrix. The system serves to reduce settlement and increase bearing capacity by replacing compressible soils (clay) soils in the upper 15 to 18 feet (depth to the dense gravel layer) below the footing with a “stiffer” composite soil matrix. The piers are constructed in a grid pattern either under footings and or fill areas. Rammed aggregate pier elements typically cover approximately 30 percent of the footing footprint area. Gravel is typically not placed
between the piers and individual footings. The piers are typically constructed a minimum distance of 12 inches above the bottom of footing elevation. The top of the pier is then “scrapped off” to footing subgrade using a smooth lipped excavator bucket. The top of the pier is then inspected to ensure it is well compacted and undisturbed at footing subgrade elevation. The building foundation is then designed utilizing conventional spread footings.

DOWL HKM have been discussing this project with Mr. John Martin of Geotech Foundation Company-West (GTFC-WEST), who designs and installs rammed aggregate piers, in regard to the applicability of using rammed aggregate piers for this project. Based on structural loads provided to date and subgrade conditions, rammed aggregate piers are a viable foundation alternative for this project. GTFC-WEST indicate that for this site that footings placed on rammed aggregate pier improved foundation soils could be designed for an allowable bearing capacity of 5,500 pounds per square foot. Estimated settlement for footings designed accordingly would be total settlements of less than 1 inch and ½ inch or less differential settlement.

**Seismic Design Methodology for Rammed Aggregate Piers:** Unlike drilled piers or driven piling rammed aggregate piers are not considered part of the foundation system for seismic design. Lateral load resistance is required for drilled piers and driven piling foundations because they are structurally connected to the foundation elements. Rammed aggregate piers are used to improve (reinforce) the foundation soils in order to increase bearing capacity, minimize settlements and mitigate liquefaction potential if needed. Rammed aggregate piers have been utilized in Seattle for many building projects to mitigate liquefaction potential conditions. Seismic foundation design for foundation soils improved by rammed aggregate piers treat the foundation as a spread footing condition where seismic resistance is provide by sliding resistance between the top of the rammed aggregate pier and concrete footing and passive pressure resistance provided by the backfill material or floor slabs.

**Design /Build Process:** Rammed aggregate pier design/installation is a proven technology and has been used extensively for many projects in the United States. Rammed aggregate piers are incorporated into a specific project under a design/build contractual process. That is, the current industry consists of established rammed aggregate pier companies that provide design, installation and warranty service. Geotechnical and structural information is provided to the rammed aggregate pier companies. They then utilize the information to develop an appropriate rammed aggregate pier design for the project. The company then installs the piers complying with an extensive quality assurance program which monitors compaction and placement of the rammed aggregate pier. Test piers are installed to confirm the stiffness moduli used for design. A representative of the project geotechnical engineer is also onsite to observe and confirm that the rammed aggregate pier company complies with the submitted quality assurance program.
Rammed Aggregate Pier Considerations:

1. The piers should extend to the dense gravel layer which is encountered at the approximate depths ranging from 14.5 to 18 feet.

2. Footings placed on the rammed aggregate pier improved foundation soils may be designed for an allowable bearing pressure of 5,500 pounds per square foot. Estimated settlement for footings designed accordingly are total settlements of less than 1 inch and ½ inch or less differential settlement.

3. Footings placed on the piers may be designed to resist sliding using a coefficient of friction of 0.45.

4. The RAP designer installer should submit a quality control /assurance plan prior to mobilizing to the site.

5. A representative of the project geotechnical engineer must be onsite to observe and confirm that the rammed aggregate pier company complies with the submitted quality assurance program.

6. The tops of all aggregate piers must be inspected for compactness (density) prior to placement of footings.

7. A minimum of one demonstration pier should be installed with the Contractors standard procedures and load tested to confirm the stiffness modulus. The contractor is responsible for setting up and recording test results. The test will also be observed and recorded by the project geotechnical engineer.

5.2.1.2 Drilled Piers

The proposed structures may be supported on drilled piers end bearing in the siltstone and sandstone bedrock which are encountered at depths ranging from approximately 35 to 45 feet below existing ground. Because of the relatively thin dense gravel layer with underlying medium dense sand and silty layers it is recommended to extend the drilled piers through these layers into the bedrock. The allowable bearing capacities have been determined by assuming contribution of end bearing and skin friction and using the “Beta” Analysis Method. A safety factor of 3 has been used to determine allowable end bearing and contributing skin friction. Anticipated total settlement for this type of foundation is estimated to be 1/4-inch. The drilled piers should extend a minimum distance of 4 feet into the siltstone and sandstone bedrock. Therefore, based on the information from four borings, the pier lengths will vary from approximately 39 to 49 feet below existing ground.
Table 5-3
Allowable Capacities for Drilled Piers

<table>
<thead>
<tr>
<th>Pier Diameter (Feet)</th>
<th>Downward Capacity (Tons)</th>
<th>*Uplift Capacity (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>85</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>155</td>
<td>63</td>
</tr>
<tr>
<td>4</td>
<td>233</td>
<td>80</td>
</tr>
</tbody>
</table>

*Plus the weight of the pier. Uplift capacities shown assume reinforcement within the entire pier length and a factor of safety of 3 for allowable side resistance.

A minimum diameter of 24 inches is recommended to facilitate proper cleaning and inspection of the pier excavations.

Pier spacing should be not less than 3.0 pier diameters measured from outside edge to outside edge of the piers. For pier spacing less than 3.0 pier diameters, piers will behave as a group and individual pier capacities may be reduced. Capacity reduction will depend upon pier spacing and the numbers of piers within the group. If closer spacings are required, DOWL HKM should be notified so that appropriate reduction factors can be provided based on actual pier/pile layout.

Drilled Pier Considerations:

1. The drilled piers should be constructed in accordance to ACI 360.1

2. Concrete placed in pier excavations using the wet method of installation should be a fluid mix with a minimum slump of 6 to 8 to prevent voids from forming around the reinforcing steel inches, while at the same time maintaining minimum 28-day-4000 psi strength requirements.

3. The geotechnical engineer must confirm drilled pier embedment depths and end bearing foundation conditions during construction.

4. A minimum of three load tests should be conducted on select piers using the dynamic load testing method to confirm capacities.

5. A project survey benchmark should be established and used to confirm pier end bearing elevations.

6. Groundwater will be encountered at depth of 20 feet and possibly higher. Temporary casing of the drilled pier holes will be required to prevent sloughing of the boring walls or the alternate slurry method of installation may be used.

7. The bearing soils for the drilled piers will consist of bedrock deposits. It is imperative that all loose slough should be removed from the bottom of the pier boring. Loose material in the bottom
of the hole will be compressible and may cause excessive settlement of the pier if not removed. The pier installation contractor shall utilize the appropriate cleaning bit to achieve a clean, slough free bottom.

8. It is noted that heaving sand conditions were encountered in some of the exploration borings. Temporary casing of the drilled pier excavations will likely be required.

9. The drilled pier installer should be equipped with appropriate drilling equipment and be prepared for any difficulties resulting from drilling into and through dense to very dense gravels as well as sloughing of granular soil. Pre-submittals by the contractor indicating means and methods and equipment to be used should be required.

10. Pumping directly from the drilled pier excavations for dewatering purposes should not be used. Dewatering in this manner may compromise the integrity of the relatively soft bedrock in the bottom of the excavations from differential hydrostatic pressures and will affect the pier end bearing conditions. Water, Polymer additives or the slurry method may be utilized to prevent caving of the pier excavation walls and during advancement.

11. Casing should be withdrawn as the concrete is tremmied while maintaining the casing bottom below the top of the concrete.

12. It is suggested that this project be reviewed with an experienced drilled pier installation contractor to discuss the drilled pier installation considerations.

5.2.1.3 Driven Piling

Steel H-piles fitted with driving points driven to required capacities in the sandstone and siltstone bedrock may be used to support the structural loads. The piles will have to be driven through the dense gravel layer and medium dense to dense sand and silt deposits into the underlying bedrock.

It is noted that that driven H-Piles were used for the MSU Engineering and Physical Science building which was constructed in July of 1994 located on the southeast corner of South 7th Avenue and Grant Street. Subgrade conditions were similar to those encountered at this project site. The pilings used were HP-12x74 and HP 10x57. A static load test was conducted on a HP 12x74 test pile which indicated an ultimate capacity greater than 360 tons could be achieved. The recommended design working load for these piles was 130 tons. Based on review of pile driving records it is noted that the installed pile embedment lengths varied considerably and ranged from 31 feet to greater than 51 feet. This is because the bedrock consistency varies and also the recommended design capacities for the piles are considered quite high given the relatively soft bedrock conditions. The variance in pile embedment lengths could be an issue in regard to contractor bidding and payments. We are therefore recommending somewhat lower pile capacities than those used for the Engineering and Physical Science building.
For estimating purposes, it is assumed that the piles will be driven into the bedrock approximately seven feet. If weathered bedrock zones are encountered, these penetration depths may be greater. The lengths of pile may vary depending on the elevation from where they are driven, weathered bedrock zones or elevation variations of the bedrock. Steel H-piles can be spliced to reduce waste caused by variable lengths.

Also to be considered with driven piling is that considerable vibrations will be induced into the surrounding soils and possibly into the adjacent structures. The vibrations could cause settlements or other damage to the older buildings in the vicinity of the new buildings.

**Allowable Capacities:** The axial capacities have been determined based on soil boring information, laboratory test results, static analysis using the DRIVEN Software program and review of previous pile installations at MSU. The following table may be used when evaluating steel H-piles for design considerations. It is assumed the piling would be driven seven feet into the siltstone and sandstone bedrock. Anticipated settlements are less ¼ inch.

### Table 5-4

<table>
<thead>
<tr>
<th><em>Pile Section</em></th>
<th>Allowable Axial Load (Tons)</th>
<th>Allowable Uplift (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 10x57</td>
<td>80</td>
<td>14</td>
</tr>
<tr>
<td>HP 12x74</td>
<td>100</td>
<td>20</td>
</tr>
</tbody>
</table>

* Piles should consist of 50 ksi steel

2. The contractor should select a driving hammer and cushion combination capable of installing the selected piling without overstressing the pile material. The contractor should submit the pile-driving plan and the pile hammer-cushion combination to the geotechnical engineer for evaluation of the driving stresses well in advance of pile installation.

3. A static load test should be conducted on one test pile to confirm capacity.

4. The pile-driving system should be analyzed using the wave equation to evaluate the potential for overstressing of the pile materials during driving.

5. It is recommended the Pile Driving Analyzer (PDA) testing be conducted on a minimum of ten (10) production piles at various locations within the building foot prints to ensure capacities are being achieved. These piles should be designated as test piles. Test piles are typically driven five (5) feet below the anticipated final pile tip elevations to further confirm capacities. This requirement could be adjusted based on the results of the PDA testing during pile installation.

6. We recommend pile spacing of equal to or greater than three pile diameters. For driven piles with spacing of greater than three pile diameters, the axial load capacity for a group will be the sum of
the individual capacities.

7. During driving of the pile sections, Pile Driving Analyzer (PDA) monitoring should be performed to ensure that the existing structures and equipment within the area are not subjected to vibration damage.

8. A representative of the geotechnical engineer should observe pile-driving operations on a full-time basis. Each pile should be observed and checked for buckling, crimping, and alignment; penetration resistance, depth of penetration, and general pile driving operations should be recorded.

9. Driven piles should be designed to resist lateral loads using a modulus of horizontal subgrade reaction of 5 tcf (tons per cubic foot) for the clay soils, subgrade reaction of 40 tons per cubic foot (tcf) for the medium dense to dense natural sand and gravel.

5.2.1.4 Screw Piles

Screw piles consist of 5.5 to 9 inch diameter pipe piles with helixes welded on. The piles consist of 85ksi steel (usually ½ inch thick). All helix welds conform to AWS and ASTM standards. The piles are installed by large tracked excavators with torque converters. Capacities are confirmed by relating installation torque to bearing capacities. Screw piles have been used for many building and parking garage projects and are a proven technology. Screw Piles were utilized for foundation support for the Gallatin County Detention Center which was constructed in 2005. Foundation conditions at the detention center are somewhat similar to conditions at the proposed Innovation Center. A static load test was conducted on a screw pile during the Gallatin County Project to confirm capacities and indicated that ultimate capacity of 325 kips was achieved for a 5.5 inch diameter pile with two helixes. We have discussed the project foundation conditions with Mr. Mike Oliveira of Alpine Site Services Inc. Denver Co., who oversaw installation of the Screw Piles at the Detention Center Project. Based on his review of the foundation conditions at the Innovation center site Mr. Oliveira is confident that Screw Piles are a feasible foundation alternative for the Innovation Project. DOWL HKM also believes that Screw Piles may be a cost effective option. DOWL HKM observed the static load test for the Screw Pile at the Detention Center and installation of several of the piles. Information in regard to Screw Piles is included in Appendix D.

Based on conversations with Mr. Olivia, and the testing that was conducted for the detention center, the following allowable capacity may be used for project planning purposes. Larger capacities may be achieved with larger pipe diameters. The Screw Piles should bear within the siltstone and sandstone bedrock deposits.
Table 5-5
Screw Pile Allowable Axial Capacities

<table>
<thead>
<tr>
<th>*Pile Section</th>
<th>Allowable Axial Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5 inch diameter</td>
<td>70 tons</td>
</tr>
<tr>
<td>Screw Pile</td>
<td></td>
</tr>
</tbody>
</table>

*Piles to consist of 85 ksi steel

1. Screw Piles should be designed in coordination with Alpine Site Services Inc. or other experienced qualified Screw Pile design/installer.

2. Static load tests should be conducted multiple piles at various locations to confirm capacities.

All exterior foundation walls should be placed at a minimum depth of 3.5 feet below final exterior grade for frost protection.

A 1/3 increase in the allowable bearing pressure may be assumed for transient loadings.

5.2.2 Lateral Pressures

The following values may be utilized for resistance to soil lateral loads on foundation walls, grade beams and footings,

Table 5-6
Lateral Loads
Clay and Silt Backfill

<table>
<thead>
<tr>
<th>Condition</th>
<th>Coefficient of Earth Pressure</th>
<th>$\gamma K$ (equivalent fluid pressure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Backfill</td>
<td>$K_o = 0.64$</td>
<td>70 pcf</td>
</tr>
<tr>
<td></td>
<td>$K_a = 0.47$</td>
<td>50 pcf</td>
</tr>
<tr>
<td></td>
<td><strong>$K_p = 2.2$</strong></td>
<td>230 pcf</td>
</tr>
</tbody>
</table>

*These recommendations are based on the assumption that no hydrostatic pressures exist.

**neglecting the first foot of backfill depth.

Table 5-7
Lateral Loads
Imported Gravel Backfill

<table>
<thead>
<tr>
<th>Condition</th>
<th>Coefficient of Earth Pressure</th>
<th>$\gamma K$ (equivalent fluid pressure)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level Backfill</td>
<td>$K_o = 0.37$</td>
<td>50 pcf</td>
</tr>
<tr>
<td></td>
<td>$K_a = 0.24$</td>
<td>35 pcf</td>
</tr>
<tr>
<td></td>
<td><strong>$K_p = 3.5$</strong></td>
<td>400 pcf</td>
</tr>
</tbody>
</table>

*These recommendations are based on the assumption that no hydrostatic pressures exist.

**neglecting the first foot of backfill depth.
- 20 -

- Coefficient of friction between concrete and clay $\delta = 0.25$
- Coefficient of friction between concrete and gravel $\delta = 0.45$

5.2.3 Interior Slab on Grade Floor

The existing native clay subgrade is suitable for support of interior concrete floor slabs provided a minimum of 12-inches of $\frac{3}{4}$-inch minus base gravel is utilized under the slab and proper subgrade compaction and preparation are performed as discussed below. Fill areas when encountered should be evaluated for compaction by proof rolling and compacting to required densities. Areas that cannot be compacted should be over-excavated a minimum of 12-inches and replaced with compacted base gravel. A geotextile stabilization fabric should be placed between the prepared subgrade. The geotextile fabric should be Geotex 350ST woven as manufactured by Propex or equal. The clay subgrade soils are also moisture sensitive and will become excessively soft if saturated by rainfall events and excessive tracking from construction equipment.

All concrete slab subgrade soil should be evaluated during construction by proof-rolling with heavy equipment and compacting as specified.

The 12 inches of granular base gravel fill should be compacted to not less than 95% of maximum dry density at plus or minus two percentage points of optimum moisture according to ASTM D 698. The soils should be placed in loose lifts not exceeding 8 inches to ensure uniform compaction is achieved.

After excavation to the required subgrade elevation the clay subgrade soils should be moisture conditioned and compacted to not less than 95% of maximum dry density at plus or minus 2% of optimum moisture as determined by ASTM D 698 prior placement of stabilization fabric imported granular fill placement.

Pavement/slab on-grade thickness placed on the 12 inches of cushion sand or gravel may be designed assuming a modulus of subgrade reaction (k) equal to 150 pounds per cubic inch.

5.2.4 Interior Ramp Fill

The interior ramp to allow access to the upper floor level will consist of a triangular structural gravel fill ranging from first floor slab elevation (0 to 12 feet in height). The fill will be supported by retaining walls on each side. As the fill will be placed on the compressible clay layer that extends to depths of 15 to 18 feet a settlement analysis has been conducted utilizing the SIGMA/W computer program and consolidation theory. The results of the analysis indicate that 2.5 to approximately 3.0 inches of settlement could occur under the maximum 12 foot fill height location as a result of consolidation of the clay layer. It is anticipated that this settlement would occur relatively rapidly over two to three months. It should be confirmed with GTFC-WEST that use of rammed aggregate piers spaced underneath the fill could reduce this settlement magnitude to one inch or less. If rammed aggregate piers are not used the fill
should be placed early on or preloaded and monitored to allow settlement to occur prior to placement of structural elements. Geofoam lightweight fill could also be utilized.

5.2.5 Corrosion Considerations

The clay surface soils at the site exhibit high corrosion potential to buried metal. A minimum resistivity value of 1650 to 1950 ohm-cm and pH of 7.6 was recorded from test results on a sample of the lean clay.

All buried metal pipes and appurtenances should be protected for severe corrosive conditions.

The clay soils exhibit low corrosivity potential to concrete. A percent soluble sulfate value less than 0.1 percent was recorded from test results on a sample of the lean clay.

Type I-II Portland cement is recommended for all project concrete.

5.3 EARTHWORK

5.3.1 Site Grading and Drainage

The following criteria should be used for site preparation purposes and when preparing construction and project documents.

- All existing fill and deleterious material should be removed in their entirety from the proposed building footprint. All exposed subgrade surfaces should be free of mounds and depressions which could prevent uniform compaction. If unexpected fill or obstructions are encountered during site clearing or excavation, such features should be removed and the excavation should extend to the natural soils and thoroughly cleaned prior to fill placement and construction.

- All fill and backfill should be approved by the geotechnical engineer, moisture conditioned and placed in 8-inch loose lifts. The fill and backfill should then be compacted with an appropriately sized compactor to the following minimum dry densities as determined by ASTM D698.

  - Below Foundations = 98 percent
  - Around Foundations = 95 percent
  - All Other Fill = 95 percent

- No fill should be placed over frozen ground or in a frozen condition. All loose disturbed soil and/or fills in the base of the over-excavation should be removed from the foundation excavation prior to placement of structural fill. Footings should not be placed on either uncompacted
disturbed native soils, or uncontrolled fill. Qualified personnel should observe all footing and slab subgrades to confirm subsoil conditions.

- Imported gravel meeting the below specifications or the site soils may be used as foundation wall backfill provided proper moisture conditioning to near optimum moisture (± 2 percent) and compacted in accordance with the details presented above. If backfill is needed below foundations, only imported gravel meeting the specifications below should be used. Other imported gravel options may be used by approval of the geotechnical engineer.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>25-60</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 12</td>
</tr>
<tr>
<td>Liquid limits less than 25 and PI less than 6</td>
<td></td>
</tr>
</tbody>
</table>

- Surface water should not be allowed to accumulate and infiltrate soils near the proposed foundations. It must be controlled and directed away from the structures. A simple means of reducing moisture changes is to prevent surface water infiltration by sloping the ground away from the foundation. The recommended minimum slope within 10 feet of the building is 1 inch vertical for 1 foot horizontal. The sloped ground should be initially constructed at a greater slope to account for settlement/consolidation of exterior backfill. Within 10 feet of the foundation, the upper 12 to 18 inches of backfill should consist of less permeable, compacted clay soils. The area around the foundation should be inspected regularly, particularly after a rain event to determine if proper drainage away from the structure has been maintained.

- Roof downspouts and drains should discharge at least 10 feet beyond the limits of all foundation wall backfill.

5.3.2 Construction on Moisture Sensitive Subgrade Soils

After the topsoil and pavement fills are excavated to the first floor slab elevation, lean clay subgrade soil will be exposed during construction of the foundation elements. The lean clay is moisture sensitive and will become soft and unstable during wet weather periods. Excessive disturbance of the clay subgrade during wet weather will compromise the subgrade in areas where concrete slabs are to be installed and subsequently require additional over-excavation and replacement of unstable soils. Additional operation
of construction equipment on excessively wet clay soils could be problematic. The Contractor should be made aware of this potential and schedule his operations accordingly or construct a suitable wet weather platform (placement of gravel and or stabilization fabric) so as not to compromise the clay subgrade during construction.

5.3.3 Excavation

Based on the soils encountered, conventional earthmoving equipment should be capable of excavating the site soils. All excavations should be approved by a qualified observer prior to backfill placement.

All excavations must conform to OSHA Standards for Excavations, 29 CFR Part 1926.652 Appendix B to Subpart P. Based on field observations and laboratory tests, the majority of the soils at the site are classified as Type C using OSHA classification system. Type C soils require excavation slope angles not to exceed 1.5 H: 1 V (horizontal to vertical). Soil and moisture conditions should be continually evaluated at the time of construction to ensure compliance with OSHA requirements. The contractor should have a designated safety officer familiar with soils to monitor trench wall conditions during construction. Trench wall stability and compliance with OSHA requirements is the Contractor’s responsibility.
6.0 LIMITATIONS

The conclusions and recommendations presented in this report assume that site conditions are not substantially different than those exposed by the explorations. If during construction, subsurface conditions are observed or appear to be present that are different from those encountered in the explorations, DOWL HKM geotechnical staff should be advised promptly so that those conditions can be reviewed and recommendations reevaluated, where necessary.

If there is a substantial lapse of time between submission of this report and the start of work, and if conditions have changed due to natural causes or construction operations, DOWL HKM should review this report to determine the applicability of the conclusions and recommendations considering the changed conditions.

This report was prepared for use by the owner and their representatives. It should be made available to prospective contractors for information on factual data only and not as a warranty of subsurface conditions.

These services have been performed in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar conditions. No warranty is made or implied.

Any conclusions by a construction contractor or bidder relating to construction means, methods, techniques, sequences, or costs based upon the information provided in this report are not the responsibility of the Client or DOWL HKM.
Appendix A

Boring Logs
### Unified Soil Classification System

#### Criteria for Assigning Group Symbols and Names

<table>
<thead>
<tr>
<th>Group Descriptions</th>
<th>Soil Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLEAN GRAVELS</td>
<td>GW</td>
</tr>
<tr>
<td>Less than 5% fines</td>
<td>GP</td>
</tr>
<tr>
<td>GRAVELS w/FINES</td>
<td>GM</td>
</tr>
<tr>
<td>More than 12% fines</td>
<td>GC</td>
</tr>
<tr>
<td>SANDS</td>
<td>SW</td>
</tr>
<tr>
<td>50% or more passes</td>
<td>SP</td>
</tr>
<tr>
<td>No. 200 sieve</td>
<td>SM</td>
</tr>
<tr>
<td>SANDS w/FINES</td>
<td>SC</td>
</tr>
</tbody>
</table>

### SOIL CLASSIFICATION/LEGEND

#### COARSE-GRAINED SOILS
- **Gravels**
  - More than 50% of coarse fraction retained on No. 4 sieve
- **Sands**
  - 50% or more of coarse fraction passes No. 4 sieve

#### FINE-GRAINED SOILS
- **Clays**
  - 50% or more passes the No. 200 sieve
- **Silt & Clay Mixtures**
  - Liquid limit less than 50
  - Liquid limit greater than 50

#### HIGHLY ORGANIC SOILS
- Primarily organic matter, dark in color and has an organic odor

### Component Definitions By Gradation

<table>
<thead>
<tr>
<th>Component</th>
<th>Size Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boulders</td>
<td>Greater than 12-in.</td>
</tr>
<tr>
<td>Cobble</td>
<td>3-in. to 12-in.</td>
</tr>
<tr>
<td>Gravel</td>
<td>3-in. to No. 4 (4.75 mm)</td>
</tr>
<tr>
<td>Coarse gravel</td>
<td>3-in. to %-%</td>
</tr>
<tr>
<td>Fine gravel</td>
<td>1/4-in. to No. 4 (4.75 mm)</td>
</tr>
<tr>
<td>Sand</td>
<td>No. 4 (4.75 mm) to No. 200 (0.075 mm)</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>No. 4 (4.75 mm) to No. 10 (2.0 mm)</td>
</tr>
<tr>
<td>Medium sand</td>
<td>No. 10 (2.0 mm) to No. 40 (0.425 mm)</td>
</tr>
<tr>
<td>Fine sand</td>
<td>No. 40 (0.425 mm) to No. 200 (0.074 mm)</td>
</tr>
<tr>
<td>Silt and Clay</td>
<td>Smaller than No. 200 (0.075 mm)</td>
</tr>
</tbody>
</table>

### Relative Density or Consistency

#### Utilizing Standard Penetration Test Values

<table>
<thead>
<tr>
<th>Cohesionless Soils™</th>
<th>Cohesive Soils™</th>
</tr>
</thead>
<tbody>
<tr>
<td>N blows/ft³</td>
<td>Relative Density (%)</td>
</tr>
<tr>
<td>Very loose</td>
<td>0 to 3</td>
</tr>
<tr>
<td>Loose</td>
<td>4 to 9</td>
</tr>
<tr>
<td>Med. Dense</td>
<td>10 to 29</td>
</tr>
<tr>
<td>Dense</td>
<td>30 to 49</td>
</tr>
<tr>
<td>Very Dense</td>
<td>Over 50</td>
</tr>
<tr>
<td>Hard</td>
<td>Over 30</td>
</tr>
</tbody>
</table>

### Descriptive Terminology Denoting Components Proportions

- Use gravelly, sandy or silty as appropriate.

### Samples

- Split Spoon Sampler (2.0” OD)
- Ring Sampler (3.0” OD) *
- Shelby Tube Sampler (3.0” OD)
- Bulk Sample (auger cuttings)

### Groundwater Elevation

- Water Elevation Noted During Drilling
- Water Elevation Recorded After Drilling Complete
LOG OF BOREHOLE B-5

MATERIAL DESCRIPTION

Surface Elevation: 4921.18

5.5" +/- Topsoil, moist, dark brown, organics
Lean Clay, CL; moist to slightly moist, medium stiff to stiff, light brown, intermittent sand layers

Groundwater observed at 18.5 feet

Silty Sand, SM; wet, medium dense to dense, light brown, slightly to non-plastic

DOWL
130 North Main St.
Butte, Montana 59701
Telephone: (406) 723-8213
www.dowl.com
## LOG OF BOREHOLE B-5

**CLIENT**  
A&E Architects

**PROJECT**  
MSU NAIC Parking Garage

**BORING LOCATION**  
Northwest Corner of Parking Garage

**SITE**  
Montana State University

### MATERIAL DESCRIPTION

**Surface Elevation: 4921.18**

<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>ELEVATION (FT.)</th>
<th>BULK DENSITY</th>
<th>GRAVITY FACTOR</th>
<th>N VALUE</th>
<th>PL</th>
<th>LL</th>
<th>ADDITIONAL DATA/REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td></td>
<td></td>
<td>4887</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40.0</td>
<td>Silty Sand, SM; wet, dense to very dense, light yellow brown</td>
<td></td>
<td>4881.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40.5</td>
<td></td>
<td></td>
<td>4882.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45.0</td>
<td>Siltstone (Silty Sand, SM); very moist, very dense, light yellow brown</td>
<td></td>
<td>4876.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lab #7809</td>
</tr>
<tr>
<td>45.5</td>
<td></td>
<td></td>
<td>4873.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>California Sampler</td>
</tr>
<tr>
<td>49.5</td>
<td>Poorly Graded Gravel with Cobbles and Sand, GP; wet, very dense, gray, minor clay observed</td>
<td></td>
<td>4869.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>USCS=SM</td>
</tr>
<tr>
<td>54.0</td>
<td>Siltstone, (Silty Sand, SM); very moist to wet, very dense, light gray, sub rounded, medium grained sand, poorly cemented</td>
<td></td>
<td>4867.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Gravel=4%</td>
</tr>
<tr>
<td>56.5</td>
<td>Boring terminated at 56.5 feet</td>
<td></td>
<td>4864.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sand=70%</td>
</tr>
<tr>
<td>58.5</td>
<td>No groundwater observed</td>
<td></td>
<td>4862.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fines=26%</td>
</tr>
<tr>
<td>63</td>
<td></td>
<td></td>
<td>4859</td>
<td></td>
<td></td>
<td>12/18</td>
<td>50/ 4&quot;</td>
<td>100%</td>
<td>Blow counts unadjusted for large split spoon</td>
</tr>
</tbody>
</table>

**LABORATORY TESTS**

- **Sample No.: 7809**
- **Note:** Test performed on 05/20/2015.

**ADDITIIONAL DATA/REMARKS**

- **Surface Elevation:** 4921.18
- **Boring terminated at 56.5 feet**
- **No groundwater observed**
<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>Material Description</th>
<th>Graphic Log</th>
<th>Elevation (ft)</th>
<th>BULK</th>
<th>Blows per 6&quot;</th>
<th>N Blows/ft</th>
<th>Pocket Penetrometer, TSF</th>
<th>M.C.</th>
<th>PL</th>
<th>LL</th>
<th>Additional Data/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-0.2</td>
<td>3&quot; Asphalt Pavement, black Road Base, Well Graded Gravel with Sand, GW; moist, brown, angular to sub angular, fine to coarse grained sand</td>
<td>4922.04</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>10/18 56%</td>
<td></td>
<td></td>
<td></td>
<td>USCS=CL Liquid Limit=34</td>
</tr>
<tr>
<td>1.0</td>
<td>Lean Clay, CL; moist to slightly moist, medium stiff to stiff, light brown, trace sand and silt, medium plasticity</td>
<td>4909.5</td>
<td>3</td>
<td>12</td>
<td>4</td>
<td>8</td>
<td>14/18 78%</td>
<td></td>
<td></td>
<td></td>
<td>Plasticity Index=11</td>
</tr>
<tr>
<td>4.5-16.2</td>
<td>Poorly Graded Gravel with Clay, GP-GC; moist, very dense to dense, multi-colored to light gray, sub angular to rounded</td>
<td>4906.09</td>
<td>5</td>
<td>15</td>
<td>7</td>
<td>8</td>
<td>22/24 92%</td>
<td></td>
<td></td>
<td></td>
<td>Consolidation Cc=0.12</td>
</tr>
<tr>
<td>18-22.5</td>
<td>Groundwater observed at 21.1 feet</td>
<td>4905</td>
<td>4</td>
<td>56</td>
<td>5</td>
<td>4</td>
<td>18/18 100%</td>
<td></td>
<td></td>
<td></td>
<td>Unconfined (qu)=1.507 ksf</td>
</tr>
<tr>
<td>25.5-31.5</td>
<td>Silty Sand, SM; wet, dense, light brown to multi-colored, medium to fine grained sand, trace clay</td>
<td>4896</td>
<td>8</td>
<td>44</td>
<td>18</td>
<td>26</td>
<td>18/18 100%</td>
<td></td>
<td></td>
<td></td>
<td>Cohesion (qu/2)=0.754 ksf</td>
</tr>
</tbody>
</table>

**Tests**

- **N Value**: 22/24 92%
- **Natural Moisture**: 24.5%
- **Consolidation Cc**: 0.12
- **Unconfined (qu)**: 1.507 ksf
- **Cohesion (qu/2)**: 0.754 ksf
- **Dry Unit Weight**: 93.3 pcf
- **Lab #7811**: Nat. Moisture=22.3%
**LOG OF BOREHOLE B-6**

**Project No.: 4522.11447.01**

**CLIENT**
A&E Architects

**PROJECT**
MSU NAIC Parking Garage

**BORING LOCATION**
Northeast Corner of Parking Garage

**SITE**
Montana State University

---

**DEPTH (FT.)**

<table>
<thead>
<tr>
<th>MATERIAL DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>ELEVATION (FT.)</th>
<th>BULK SAMPLES</th>
<th>GRAPHIC LOG</th>
<th>ELEVATION (FT.)</th>
<th>ADDITIONAL DATA/REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Elevation: 4922.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35.0</td>
<td>Poorly Graded Sand, SP; wet, medium dense, yellow brown</td>
<td>4887.29</td>
<td>17</td>
<td>7</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>36.5</td>
<td></td>
<td>4887.9</td>
<td>8</td>
<td>3</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>43.5</td>
<td>Siltstone, (Silty Sand, SM); wet to very moist, very dense, brown, fine grained sand</td>
<td>4878.79</td>
<td>50</td>
<td>50</td>
<td>11</td>
<td>2/2</td>
</tr>
<tr>
<td>45.2</td>
<td></td>
<td>4877.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boring terminated at 45.2 feet</td>
<td></td>
<td></td>
<td>Groundwater observed at 45.2 feet</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**BOWRN LOCATION**

**SITE**
Montana State University

**DRILL CO.**
HazTech

**DRILL RIG**
Longyear BK-81

**DRILLER**
Paul Bray

**HUMMER**
Auto

**LOGGED BY**
J. Potts

**APPROVED BY**
G. Underhill

---

**STARTED**
5/21/2015

**FINISHED**
5/21/2015

---

**DOWL**
2090 Stadium Drive
Bozeman, Montana 59715
Telephone: (406) 586-8834
www.dowl.com
7" +/- Topsoil, very moist, black, organics

Fill, Poorly Graded Gravel, GP; moist, loose, brown

Lean Clay, CL; moist, medium stiff to stiff, light to dark brown, medium plasticity

Groundwater observed at 21.35 feet

Poorly Graded Gravel with Clay, GP-GC; moist to very moist, dense to very dense, multi-colored to light gray, rounded

Silty Sand, SM; wet, medium dense, light brown, non-plastic, clayey in part
<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>35.0</td>
<td>6&quot; well rounded and medium grained sand lenses observed at 35.0 feet</td>
</tr>
<tr>
<td>38.0</td>
<td>Poorly Graded Sand with Gravel, SP; wet, very dense, light gray to multi-colored, sub rounded to well grounded, fine to coarse grained sand</td>
</tr>
<tr>
<td>45.0</td>
<td>Sandstone (Poorly Graded Sand, SP); wet, very dense, light brown to light gray, very weakly cemented</td>
</tr>
</tbody>
</table>

**ADDITIONAL DATA/REMARKS**
- Heavy sand in aguer from 35 to 38'
- Hard slow rough drilling 43.5 to 45 feet
- Smooth rock drilling at 55.0 feet
- Smooth-soft drilling with bit
- 3 feet of heavy sand in aguer at 60.0 feet
- Smooth-soft drilling with bit

**TESTS**

<table>
<thead>
<tr>
<th>N VALUE</th>
<th>BLOWS/FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL</td>
<td>66</td>
</tr>
<tr>
<td>LL</td>
<td>29</td>
</tr>
</tbody>
</table>

**NUMBER IN. RECOVERED**

**IN. DRIVEN**

**POCKET PENETROMETER, TSF**

**M.C.**

**GRAPHIC LOG**

**LOGGED BY** J. Potts

**APPROVED BY** G. Underhill
Project No.: 4522.11447.01

LOG OF BOREHOLE B-7

Sheet 3 of 3

CLIENT: A&E Architects

PROJECT: MSU NAIC Parking Garage

BORING LOCATION: Southeast Corner of Parking Garage

SITE: Montana State University

Depth (ft.) | Material Description
---|---
67.5 | Siltstone, (Silty Sand/Sandy Silt, (SM/ML)); wet, very dense, light brown, non-plastic
72 | 4860
72.5 | 4855.5
76.5 | 4851
78.0 | Siltstone, (Silty Sand, SM); wet, very dense, light brown to multi-colored, non-plastic
81.5 | Boring terminated at 81.5 feet
81.5 | Groundwater observed at 81.5 feet

Surface Elevation: 4925.41

Excessive heavy sand in aguers, no sampling from 65 to 75 feet

Drilling with full weight on bit

Full weight on bit

DOWL
2090 Stadium Drive
Bozeman, Montana 59715
Telephone: (406) 586-8834
www.dowl.com

STARTED 5/22/2015
FINISHED 5/22/2015

DRILL CO. HazTech
DRILL RIG Longyear BK-81
DRILLER Paul Bray
HAMMER Auto
LOGGED BY J. Potts
APPROVED BY G. Underhill
### LOG OF BOREHOLE B-8

**CLIENT**  
A&E Architects

**PROJECT**  
MSU NAIC Parking Garage

**BORING LOCATION**  
Center of Parking Garage

**SITE**  
Montana State University

<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>ELEVATION (FT.)</th>
<th>BULK DRENCH/PUSH BLOWS PER 6&quot; N BLOWS/FT</th>
<th>N.RECOVERED IN DRIVEN POCKET PENETROMETER, TSF</th>
<th>N.VALUE</th>
<th>M.C.</th>
<th>PL</th>
<th>LL</th>
<th>ADDITIONAL DATA/REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>6&quot; +/- Topsoil, moist, dark gray, organics</td>
<td></td>
<td>4922.87</td>
<td>2</td>
<td>1</td>
<td>11/18</td>
<td>81%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|             | Lean Clay with Sand, CL; slightly moist, medium stiff to stiff, brown, medium plasticity |             | 4918.5         | 4                                        | 14/18                                         | 78%     |      |    |    | Lab #7812  
|             | Dowl #7812  
|             | Nat. Moisture=19.5%  
|             | Resistivity=1,615 Ohm-Cm                                                             |             | 4914           | 5                                        | 17/18                                         | 94%     |      |    |    |                         |
| 13.5        | Poorly Graded Gravel with Clay, GP-GC; slightly moist to moist, very dense, gray to multi-colored, sub rounded to well rounded, medium to fine grained sand |             | 4908.37        | 4                                        | 5/4                                           | 125%    |      |    |    |                         |
|             | Groundwater observed at 19.5 feet                                                    |             | 4906           | 5                                        | 5/5                                           | 100%    |      |    |    |                         |
| 23.5        | Silty Sand, SM; wet, medium dense to very dense, light brown, trace clay              |             | 4899.87        | 5                                        | 18/18                                         | 100%    |      |    |    |                         |

**STARTED**  
5/20/2015

**FINISHED**  
5/20/2015

**DRILL CO.**  
HazTech

**DRILL RIG**  
Longyear BK-81

**DRILLER**  
Paul Bray

**HAMMER**  
Auto

**LOGGED BY**  
J. Potts

**APPROVED BY**  
G. Underhill
MATERIAL DESCRIPTION

Surface Elevation: 4923.37

36.0

Siltstone, (Silty Sand, SM); wet, medium dense to very dense, light brown, slightly to non-plastic

40.5

Poorly Graded Gravel with Sand and Silt, GP-GM; wet, very dense, light brown to multi-colored, sub rounded

48.8

Sandstone, (Poorly Graded Sand, SP); wet to very moist, very dense, light brown to multi-colored, medium to fine grained sand

52.0

Boring terminated at 55.2 feet

58.5

Groundwater observed at 19.5 feet

Lab #7810
California Sampler
USCS=SM
Gravel=6%
Sand=77%
Fines=17%
Liquid Limit=NV
Plasticity Index=NP
Wet Unit Weight=115.7 pcf
Nat. Moisture=27.6%
Blow counts unadjusted for large split spoon
Preliminary Investigation

Boring logs
<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Surface Elevation: 4924.57</td>
</tr>
<tr>
<td>1.0</td>
<td>13&quot; +/- Topsoil, very moist, black, organics</td>
</tr>
<tr>
<td>2.0</td>
<td>Sandy Silt, ML; very moist, medium stiff, brown, fine grained sand</td>
</tr>
<tr>
<td>4.0</td>
<td>Lean Clay with Sand, CL; moist, medium stiff to very stiff, brown to tan, fine grained sand, silty in part</td>
</tr>
<tr>
<td>15.8</td>
<td>Poorly Graded Gravel with Clay and Sand, GP-GC; very moist to moist, dense to very dense, brown to multi-colored, rounded to sub angular gravel, fine to coarse grained sand</td>
</tr>
<tr>
<td>21.0</td>
<td>Poorly Graded Gravel with Sand, GP; wet, very dense to dense, brown to multi-colored, sub rounded to sub angular gravel, fine to coarse grained sand</td>
</tr>
<tr>
<td>24.0</td>
<td>Groundwater observed at 21.0 feet</td>
</tr>
<tr>
<td>25.1</td>
<td>Silty Sand/Sandy Silt, SM/ML; very moist to wet, medium dense to dense/very stiff to hard, light brown, fine to medium coarse grained sand</td>
</tr>
</tbody>
</table>

**Graphical Log**

**Elevation (FT.):** 4924.57

**Tests:**
- N Value
- M.C.
- LL

**Additional Data/Remarks:**
- Lab #29897
  - Consolidation Cc=0.14
  - Unconfined qu=2.90 ksf
  - Cohesion (qu/2)=1.45 ksf
  - Dry Unit Weight=103.1 pcf
  - Nat. Moisture=19.3%
- Lab #7124
  - USCS=CL
  - Sand=24.5%
  - Fines=75.5%
  - Liquid Limit=35
  - Plasticity Index=19
  - Max Dry Unit Weight = 97.0 pcf
  - Opt. Moisture=22.2%
  - Nat. Moisture=23.3%

**Notes:**
- Gravel crushed end of Shelby tube
- Slow and rough drilling through gravel
- Smooth and slow drilling
LOG OF BOREHOLE B-1

Surface Elevation: 4924.57

- 2" thick fine to coarse grained sand and rounded gravel lenses observed at 35.0 feet
- Orange brown color at 35.0 feet
- Siltstone/Sandstone, Poorly Graded Sand with Gravel, SP; wet to very moist, very dense to dense, dark brown to multi-colored, rounded to sub angular gravel, fine to coarse grained sand (soft rock)
- Boring terminated at 51.5 feet
- Groundwater observed at 21.0 feet

DOWL HKM
2090 Stadium Drive
Bozeman, Montana 59715
Telephone: (406) 586-8834
www.dowlhk.com
**LOG OF BOREHOLE B-2**

**PROJECT**  
MSU Norm Asbjornson Innovation Center

**Boring Location**  
Northwest Corner of Parking Garage

**Site**  
Montana State University

---

**Material Description**

- **Surface Elevation:** 4921.10

- **0.7 ft:** Topsoil, very moist, black, organics
  - Fill, Silty Sand, SM; very moist, medium dense, black, organics, brick fragments
  - Sandy Lean Clay, CL; very moist to moist, stiff, tan, fine grained sand, silty in part

- **12.0 ft:** Lean Clay, CL; moist, stiff, light brown

- **16.3 ft:** Poorly Graded Gravel with Clay and Sand, GP-GC; moist to very moist, very dense, brown to multi-colored, rounded to sub angular gravel, fine to coarse grained sand

- **21.3 ft:** Poorly Graded Gravel with Sand, GP; wet, very dense, dark brown to multi-colored, rounded to sub angular gravel, fine to coarse grained sand

- **23.0 ft:** Silty Sand/Sandy Silt, SM/ML; very moist to wet, medium dense to very dense/very stiff to hard, light brown, fine grained sand

---

**Additional Data/Remarks**

- Slow and rough drilling through gravel
- California sampler pushed

---

**DOWL HKM**  
2090 Stadium Drive  
Bozeman, Montana 59715  
Telephone: (406) 586-8834  
www.dowlhk.com

**STARTED** 11/4/2014  
**FINISHED** 11/5/2014

**DRILL CO.** HazTech  
**DRILL RIG** Longyear BK-81

**DRILLER** Paul Bray  
**HAMMER** Auto

**LOGGED BY** D. Barrick  
**APPROVED BY** G. Underhill
Surface Elevation: 4921.10

-35.0 4886.1
Siltstone, Sandy Silt, ML; wet to very moist, hard, brown, clayey in part

-36.0 4884

-40.0 4881.1
Sandstone, Silty Sand, SM; wet to very moist, very dense, brown, fine to coarse grained sand

-50.1 4871
Boring terminated at 50.1 feet

Groundwater observed at 20.2 feet

Severe sand heave observed at 35.0 feet

End of drilling for 11/4/2014

Slow smooth drilling with full weight on bit

M.C. 76%
### MATERIAL DESCRIPTION

**Surface Elevation:** 4922.95

<table>
<thead>
<tr>
<th>Depth (FT.)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>3.5&quot; Asphalt Pavement, black</td>
</tr>
<tr>
<td>0.8</td>
<td>6&quot; Road Base, Well Graded Gravel with Sand, GW; moist, brown, angular to sub angular gravel, fine to coarse grained sand</td>
</tr>
<tr>
<td>3</td>
<td>Sandy Lean Clay, CL; moist to very moist, medium stiff to very stiff, brown, fine grained sand, silty in part</td>
</tr>
<tr>
<td>12.5</td>
<td>Lean Clay, CL; moist to very moist, stiff, brown to light brown</td>
</tr>
<tr>
<td>19.5</td>
<td>Poorly Graded Gravel with Clay and Sand, GP-GC; wet to very moist, dense, brown to multi-colored, rounded to sub angular gravel, fine to coarse grained sand Groundwater observed at 20.8 feet</td>
</tr>
<tr>
<td>22.5</td>
<td>Poorly Graded Gravel with Sand, GP; wet, dense, brown to multi-colored, rounded to sub angular gravel, fine to coarse grained sand</td>
</tr>
<tr>
<td>27.5</td>
<td>Sandy Silt, ML; wet to very moist, hard, brown, with fine to coarse grained sand, minor rounded gravel lenses, clayey in part</td>
</tr>
</tbody>
</table>

### LOG OF BOREHOLE B-3

**Project No.: 4522.11447.01**

**CLient:** A&E Architects

**Site:** Montana State University

**Boring Location:** South Central Portion of Innovation Center

**Client:** A&E Architects

**Project:** MSU Norm Asbjornson Innovation Center

**Site:** Montana State University

**Boring Location:** South Central Portion of Innovation Center

**Laboratory Test Results:**
- **Lab #29901**
  - **Liquid Limit:** 36
  - **Plasticity Index:** 13
  - **Consolidation Cc:** 0.14
  - **Unconfined qu:** 2.01 ksf
  - **Cohesion (qu/2):** 1.01 ksf
  - **Dry Unit Weight:** 98.0 pcf
  - **Natural Moisture:** 26.5%

**Additional Data/Remarks:**
- Slow and rough drilling through gravel
- Slow and smooth drilling with full weight on bit

---

**Log Sheet:**

**STARTED:** 11/5/2014

**FINISHED:** 11/5/2014

**DRILL CO.:** HazTech

**DRILL RIG:** Longyear BK-81

**DRILLER:** Paul Bray

**HAMMER:** Auto

**LOGGED BY:** D. Barrick

**APPROVED BY:** G. Underhill

**DOWL HKM**

2090 Stadium Drive
Bozeman, Montana 59715
Telephone: (406) 586-8834
www.dowlhk.com
### LOG OF BOREHOLE B-3

**CLIENT:** A&E Architects  
**PROJECT:** MSU Norm Asbjornson Innovation Center  
**BORING LOCATION:** South Central Portion of Innovation Center  
**SITE:** Montana State University

<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>ELEVATION (FT.)</th>
<th>BULK SAMPLES</th>
<th>DRIVEN/PUSH BLOWS PER 6&quot;</th>
<th>NUMBER</th>
<th>IN. RECOVERED IN. DRIVEN</th>
<th>POCKET PENETROMETER, TSF</th>
<th>PL</th>
<th>M.C.</th>
<th>LL</th>
<th>ADDITIONAL DATA/REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>California sampler pushed</td>
</tr>
<tr>
<td>35.0</td>
<td>Siltstone, Sandy Silt, ML; wet to very moist, hard, brown, with fine to coarse grained sand, clayey in part (very soft rock)</td>
<td>4887.95</td>
<td>18/18 100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rough and very slow drilling at 41.0 feet</td>
</tr>
<tr>
<td>40.0</td>
<td>Sandstone, Poorly Graded Sand with Silt, SP- SM; wet, very dense, brown</td>
<td>4882.95</td>
<td>18/18 100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42.0</td>
<td>Boring terminated due to auger refusal at 42.0 feet</td>
<td>4880.95</td>
<td>9/9 100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Groundwater observed at 20.8 feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Surface Elevation:** 4922.95
## LOG OF BOREHOLE B-4

### CLIENT
A&E Architects

### PROJECT
MSU Norm Asbjornson Innovation Center

### BORING LOCATION
Northeast Corner of Innovation Center

### SITE
Montana State University

### MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
<th>GRAPHIC LOG</th>
<th>ELEVATION (FT.)</th>
<th>SAMPLER</th>
<th>TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>4&quot; Asphalt Pavement, black</td>
<td></td>
<td>4919.86</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>0.8</td>
<td>5&quot; Road Base, Well Graded Gravel with Sand, GW; moist, brown, sub angular gravel, fine to coarse grained sand</td>
<td></td>
<td>4919.36</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>1.8</td>
<td>Fill, Lean Clay with Sand, CL; moist, medium stiff, black, fine grained sand</td>
<td></td>
<td>4918.56</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4.5</td>
<td>Sandy Lean Clay, CL; moist, medium stiff, brown, fine grained sand, silty in part</td>
<td></td>
<td>4914</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9.0</td>
<td>Lean Clay, CL; slightly moist, soft to stiff, tan to cream white</td>
<td></td>
<td>4909.9</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>13.5</td>
<td>Groundwater observed at 20.0 feet</td>
<td></td>
<td>4900.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>18.5</td>
<td>Poorly Graded Gravel with Sand, GP; wet, very dense, brown to dark brown, angular to sub rounded gravel, fine to coarse grained sand</td>
<td></td>
<td>4899.66</td>
<td>23</td>
<td>33</td>
</tr>
<tr>
<td>22.5</td>
<td>Silty Sand/Sandy Silt, SM/ML; very moist to wet, medium dense to very dense/very stiff to hard, brown, fine to medium grained sand, clayey in part</td>
<td></td>
<td>4892.66</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>27.5</td>
<td></td>
<td></td>
<td>4891.0</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>31.5</td>
<td></td>
<td></td>
<td>4887</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

### ADDITIONAL DATA/REMARKS
- Lab #29904
  - Consolidation Cc=0.09
  - Unconfined qu=2.27 ksf
  - Cohesion (qu/2)=1.14 ksf
- Lab #7125
  - Liquid Limit=35
  - Plasticity Index=19

- Slow and rough drilling through gravel
- Smooth and slow drilling
<table>
<thead>
<tr>
<th>DEPTH (FT.)</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>36.0</td>
<td>2&quot; thick fine to coarse grained sand and rounded gravel lenses observed at 36.3 feet</td>
</tr>
<tr>
<td>40.0</td>
<td>Siltstone, Sandy Silt, ML; wet to very moist, hard, brown</td>
</tr>
<tr>
<td></td>
<td>becoming more competent with depth</td>
</tr>
<tr>
<td>55.0</td>
<td>Sandstone, Silty Sand, SM; wet to very moist, very dense, brown, fine to coarse grained sand</td>
</tr>
<tr>
<td>60.3</td>
<td>Boring terminated at 60.3 feet</td>
</tr>
<tr>
<td></td>
<td>Groundwater observed at 20.0 feet</td>
</tr>
</tbody>
</table>

**Surface Elevation: 4920.16**
Appendix B

Laboratory Test Results
## SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

| LAB NUMBER | LOCATION | DEPTH RANGE | CLASSIFICATION SYMBOL | FINE'S SMALLER THAN 0.075mm | LIQUID LIMIT - % | PLASTICITY INDEX - % | CONSOLIDATION - Pc (ksf) | CONSOLIDATION - Cc (ksf) | UNIT WT. (CALIF. TUBE) - WET (pcf) | UNIT WT. (UNCONF.) - DRY (pcf) | UNCONF. STRENGTH - qu (ksf) | UNCONF. COHESION - qu/2 (ksf) | NATURAL MOISTURE - % | RESISTIVITY (Ohm-Cm) | Saturated | pH | WATER SOLUBLE SO4 - % |
|------------|----------|-------------|------------------------|----------------------------|------------------|------------------------|---------------------------|---------------------------|----------------------------------|-----------------------------|--------------------------|-------------------------------|--------------------------|-----------------|-------------------|
| 7809       | B-5      | 40.0'-41.5' | SM                     | 26.0                       | 70.0             | 4.0                    | NV                        | NP                        | 106.5                            |                            |                          |                              |                          | 26.0            | 70.0              | 4.0               |
| Tetra      | B-6      | 10.0'-11.85'| CL                     | 34                         | 11               | 3.62                   | 0.12                      | 93.3                      | 1.507                            | 0.754                       | 24.5                     |                              |                          | 22.3            |                   |                   |
| 7811       | B-6      | 13.0'-13.5' | CL                     | 31                         | 11               | 3.62                   | 0.12                      | 93.3                      | 1.507                            | 0.754                       | 24.5                     |                              |                          | 22.3            |                   |                   |
| Tetra      | B-7      | 10.0'-11.6' | CL                     | 43                         | 15               | 2.70                   | 0.08                      | 86.6                      | 1.743                            | 0.872                       | 23.5                     |                              |                          | 23.5            |                   |                   |
| 7812       | B-8      | 5.0'-6.5'   | SM                     | 17.0                       | 77.0             | 6.0                    | NV                        | NP                        | 115.7                            |                            |                          |                              |                          | 19.5            | 1950             | 1615              |
| 7810       | B-8      | 36.0'-36.5' | SM                     | 17.0                       | 77.0             | 6.0                    | NV                        | NP                        | 115.7                            |                            |                          |                              |                          | 27.6            |                   |                   |
Particle Size Distribution Report

**Material Description**

SILTY SAND

**Atterberg Limits (ASTM D 4318)**

- PL = NP
- LL = NV
- PI = NP

**Classification**

- USCS (D 2487) = SM
- AASHTO (M 145) = A-2-4(0)

**Coefficients**

- $D_{90} = 2.0302$
- $D_{85} = 1.1639$
- $D_{60} = 0.2415$

- $D_{50} = 0.1664$
- $D_{30} = 0.0844$
- $D_{15} = \text{C}_u$
- $D_{10} = \text{C}_c$

**Remarks**

- (no specification provided)

**Test Results (ASTM C136 & ASTM C117)**

<table>
<thead>
<tr>
<th>Opening Size</th>
<th>Percent Finer</th>
<th>Spec. (%)</th>
<th>Pass? (X=Fail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>96</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#20</td>
<td>82</td>
<td></td>
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<tr>
<td>#40</td>
<td>72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#80</td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>26</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- % +3"
- % Gravel
- % Sand
- % Fines

- Coarse
- Fine
- Coarse
- Medium
- Fine
- Silt
- Clay

<table>
<thead>
<tr>
<th>% +3&quot;</th>
<th>% Gravel</th>
<th>% Sand</th>
<th>% Fines</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26</td>
</tr>
</tbody>
</table>

**Date Received:** 6/2/15  **Date Tested:** 6/4/15
**Tested By:** CS
**Checked By:** TM
**Title:**

**Location:** B-5  **Sample Number:** 7809  **Depth:** 40.0'-41.5'
**Date Sampled:** 5/20-21/15

**Client:** MONTANA STATE UNIVERSITY  **Project:** MSU PARKING GARAGE

**Project No:** 4522.11447  **LAB #** 7809
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils

MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>%&lt;#40</th>
<th>%&lt;#200</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI</td>
<td>NV</td>
<td>NP</td>
<td>NP</td>
<td>72</td>
<td>26</td>
</tr>
</tbody>
</table>

- Project No.: 4522.11447  Client: MONTANA STATE UNIVERSITY
- Project: MSU PARKING GARAGE
- Location: B-5
- Sample Number: 7809
- Depth: 40.0'-41.5'

LAB # 7809B

Tested By: GS
## CONSOLIDATION TEST REPORT

### CONSOLIDATION TEST REPORT

<table>
<thead>
<tr>
<th>Applied Pressure - ksf</th>
<th>Percent Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>10</td>
<td>-7</td>
</tr>
</tbody>
</table>

### WATER ADDED

- **Initial Void Saturation Moisture (pcf) (ksf) Ratio**
  - **Natural**
    | Saturation | Moisture | Dry Dens. (pcf) | LL | PI | Sp. Gr. | P_c (ksf) | C_c | Initial Void Ratio |
    | 73.7 %     | 24.5 %    | 88.0            | 34 | 11 | 2.65    | 3.62      | 0.12| 0.880              |

### MATERIAL DESCRIPTION

#### USCS

- **Project No.:** 4531.11447.01  
  **Client:** DOWL HKM  
  **Project:** MSU Parking Garage  
  **Source of Sample:** B-6  
  **Depth:** 10’-11.85’  
  **Remarks:** Tetra Tech  
  **Billings, MT**

#### AASHTO

**Figure**
Dial Reading vs. Time

Project No.: 4531.11447.01
Project: MSU Parking Garage
Source of Sample: B-6       Depth: 10'-11.85'

Load No. = 5
Load = 2.00 ksf
\( D_0 = 0.0102 \)
\( D_{90} = 0.0115 \)
\( D_{100} = 0.0116 \)
\( T_{90} = 5.81 \text{ min.} \)

\( C_v @ T_{90} \)
0.357 ft.²/day

Load No. = 6
Load = 4.00 ksf
\( D_0 = 0.0192 \)
\( D_{90} = 0.0214 \)
\( D_{100} = 0.0216 \)
\( T_{90} = 20.07 \text{ min.} \)

\( C_v @ T_{90} \)
0.101 ft.²/day

Figure
Project No.: 4531.11447.01
Project: MSU Parking Garage
Source of Sample: B-6  Depth: 10'-11.85'

Load No. = 7
Load = 8.00 ksf

\[ D_0 = 0.0315 \]
\[ D_{90} = 0.0348 \]
\[ D_{100} = 0.0351 \]
\[ T_{90} = 11.86 \text{ min.} \]

\[ C_v @ T_{90} = 0.167 \text{ ft}^{2}/\text{day} \]
## UNCONFINED COMPRESSION TEST

**Sample No.** 1

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconfined strength, ksf</td>
<td>1.507</td>
</tr>
<tr>
<td>Undrained shear strength, ksf</td>
<td>0.754</td>
</tr>
<tr>
<td>Failure strain, %</td>
<td>2.9</td>
</tr>
<tr>
<td>Strain rate, in./min.</td>
<td>0.060</td>
</tr>
<tr>
<td>Water content, %</td>
<td>24.5</td>
</tr>
<tr>
<td>Wet density, pcf</td>
<td>116.1</td>
</tr>
<tr>
<td>Dry density, pcf</td>
<td>93.3</td>
</tr>
<tr>
<td>Saturation, %</td>
<td>83.8</td>
</tr>
<tr>
<td>Void ratio</td>
<td>0.7737</td>
</tr>
<tr>
<td>Specimen diameter, in.</td>
<td>2.875</td>
</tr>
<tr>
<td>Specimen height, in.</td>
<td>6.000</td>
</tr>
<tr>
<td>Height/diameter ratio</td>
<td>2.09</td>
</tr>
</tbody>
</table>

**Description:** CL

**LL =** 34  **PL =** 23  **PI =** 11  **GS =** 2.65  **Type:** Undisturbed

**Project No.:** 4531.11447.01  
**Date Sampled:** 5-20-15  
**Remarks:**

**Figure:**

**Client:** DOWL HKM  
**Project:** MSU Parking Garage  
**Source of Sample:** B-6  
**Depth:** 10'-11.85'

**UNCONFINED COMPRESSION TEST**  
Tetra Tech  
Billings, MT
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils.

<table>
<thead>
<tr>
<th>WATER CONTENT</th>
<th>31.1</th>
<th>31.2</th>
<th>31.3</th>
<th>31.4</th>
<th>31.5</th>
<th>31.6</th>
<th>31.7</th>
<th>31.8</th>
<th>31.9</th>
<th>32.0</th>
<th>32.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUMBER OF BLOWS</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Project No.</th>
<th>4522.11447</th>
<th>Client: MONTANA STATE UNIVERSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project:</td>
<td>MSU PARKING GARAGE</td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td>B-6</td>
<td></td>
</tr>
<tr>
<td>Sample Number:</td>
<td>7811</td>
<td></td>
</tr>
<tr>
<td>Depth:</td>
<td>13.0’-13.5’</td>
<td></td>
</tr>
</tbody>
</table>

LEAN CLAY

<table>
<thead>
<tr>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>%&lt;#40</th>
<th>%&lt;#200</th>
<th>USCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>20</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remarks:

Tested By: GS
Checked By: TM
CONSOLIDATION TEST REPORT

Water Added

Applied Pressure - ksf

Percent Strain

<table>
<thead>
<tr>
<th>Natural Saturation</th>
<th>Dry Dens. (pcf)</th>
<th>LL</th>
<th>PI</th>
<th>Sp. Gr.</th>
<th>P_c (ksf)</th>
<th>Cc</th>
<th>Initial Void Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>69.3 %</td>
<td>23.5 %</td>
<td>87.1</td>
<td>43</td>
<td>15</td>
<td>2.65</td>
<td>2.70</td>
<td>0.08</td>
</tr>
</tbody>
</table>

MATERIAL DESCRIPTION

CL

USCS

AASHTO

Project No. 4531.11447.01  Client: DOWL HKM
Project: MSU Parking Garage

Source of Sample: B-7  Depth: 10.0'-11.6'

Tetra Tech

Billings, MT
Dial Reading vs. Time

Project No.: 4531.11447.01
Project: MSU Parking Garage

Source of Sample: B-7  Depth: 10.0'-11.6'

Load No. = 5
Load = 2.00 ksf
D₀ = 0.0083
D₉₀ = 0.0091
D₁₀₀ = 0.0092
T₉₀ = 2.46 min.

Cᵥ @ T₉₀
0.846 ft.²/day

Load No. = 6
Load = 4.00 ksf
D₀ = 0.0153
D₉₀ = 0.0171
D₁₀₀ = 0.0173
T₉₀ = 8.43 min.

Cᵥ @ T₉₀
0.244 ft.²/day
Dial Reading vs. Time

Project No.: 4531.11447.01
Project: MSU Parking Garage
Source of Sample: B-7 Depth: 10.0'-11.6'

Load No.= 7
Load= 8.00 ksf
D_0 = 0.0253
D_90 = 0.0275
D_100 = 0.0278
T_90 = 2.66 min.

C_v @ T_90
0.756 ft^2/day
### UNCONFINED COMPRESSION TEST

**Sample No.:** 1

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconfined strength, ksf</td>
<td>1.743</td>
</tr>
<tr>
<td>Undrained shear strength, ksf</td>
<td>0.872</td>
</tr>
<tr>
<td>Failure strain, %</td>
<td>4.2</td>
</tr>
<tr>
<td>Strain rate, in./min.</td>
<td>0.060</td>
</tr>
<tr>
<td>Water content, %</td>
<td>23.5</td>
</tr>
<tr>
<td>Wet density, pcf</td>
<td>106.9</td>
</tr>
<tr>
<td>Dry density, pcf</td>
<td>86.6</td>
</tr>
<tr>
<td>Saturation, %</td>
<td>68.4</td>
</tr>
<tr>
<td>Void ratio</td>
<td>0.9111</td>
</tr>
<tr>
<td>Specimen diameter, in.</td>
<td>2.875</td>
</tr>
<tr>
<td>Specimen height, in.</td>
<td>6.000</td>
</tr>
<tr>
<td>Height/diameter ratio</td>
<td>2.09</td>
</tr>
</tbody>
</table>

**Description:** CL

- **LL:** 43
- **PL:** 28
- **PI:** 15
- **GS:** 2.65
- **Type:** Undisturbed

**Client:** DOWL HKM

**Project:** MSU Parking Garage

**Source of Sample:** B-7  
**Depth:** 10.0' - 11.6'

---

**Figure:**

---

**UNCONFINED COMPRESSION TEST**

Tetra Tech

Billings, MT
### Particle Size Distribution Report

#### Atterberg Limits (ASTM D 4318)

<table>
<thead>
<tr>
<th>Material Description</th>
<th>SILTY SAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties</td>
<td></td>
</tr>
<tr>
<td>PL</td>
<td>NP</td>
</tr>
<tr>
<td>LL</td>
<td>NV</td>
</tr>
<tr>
<td>PI</td>
<td>NP</td>
</tr>
</tbody>
</table>

#### Classification

<table>
<thead>
<tr>
<th>Classifier</th>
<th>USCS (D 2487)</th>
<th>AASHTO (M 145)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse</td>
<td>SM</td>
<td>A-2-4(0)</td>
</tr>
<tr>
<td>Fine</td>
<td></td>
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</tbody>
</table>

#### Coefficients

<table>
<thead>
<tr>
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<th>Coefficient</th>
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</thead>
<tbody>
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<td>2.4780</td>
</tr>
<tr>
<td>D85</td>
<td>1.3550</td>
</tr>
<tr>
<td>D60</td>
<td>0.2778</td>
</tr>
<tr>
<td>D50</td>
<td>0.1899</td>
</tr>
<tr>
<td>D30</td>
<td>0.1512</td>
</tr>
<tr>
<td>D10</td>
<td></td>
</tr>
<tr>
<td>C_u</td>
<td></td>
</tr>
<tr>
<td>C_c</td>
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</table>

#### Remarks

- (no specification provided)

### Material Description

**SILTY SAND**

#### Test Results (ASTM C136 & ASTM C117)

<table>
<thead>
<tr>
<th>Size</th>
<th>Percent Finer</th>
<th>Spec.* (Percent)</th>
<th>Pass? (X=Fail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>98</td>
<td></td>
<td></td>
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<tr>
<td>#4</td>
<td>94</td>
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<tr>
<td>#10</td>
<td>88</td>
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<td>#20</td>
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<td>#40</td>
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<td>#80</td>
<td>48</td>
<td></td>
<td></td>
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<td>#100</td>
<td>29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>17</td>
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<td></td>
</tr>
</tbody>
</table>

#### Opening Percent Spec.

<table>
<thead>
<tr>
<th>Size</th>
<th>% Gravel Coarse</th>
<th>% Sand Coarse</th>
<th>% Sand Medium</th>
<th>% Sand Fine</th>
<th>% Fines Silt</th>
<th>% Fines Clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>19</td>
<td>52</td>
<td>17</td>
</tr>
</tbody>
</table>

* (no specification provided)

### Location

- **Location:** B-8
- **Sample Number:** 7810
- **Depth:** 36.0'-36.5'
- **Date Sampled:** 5/20-21/15

### Client

- **Client:** MONTANA STATE UNIVERSITY

### Project

- **Project:** MSU PARKING GARAGE
- **Project No:** 4522.11447
- **LAB #:** 7810

### Date

- **Date Received:** 6/2/15
- **Date Tested:** 6/4/15
- **Date Sampled:** 5/20-21/15
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils.

MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS
--- | --- | --- | --- | --- | --- | ---
SILTY SAND | NV | NP | NP | 69 | 17 | SM

Project No. 4522.11447  Client: MONTANA STATE UNIVERSITY

Project: MSU PARKING GARAGE

Location: B-8  Sample Number: 7810  Depth: 36.0'-36.5'

Remarks:

LAB # 7810B
### RESISTIVITY MEASUREMENT

**ASTM G57**

**Project:** MSU Parking Garage  
**Lab No:** 7812  
**Project No:** 4531.11447.01  
**Field No:** B-8  
**Sample Location:** B-8@5.0'-6.5'  
**Date Sampled/By:** 5/20-21/15  
**Date Test/By:** 6/3/15 TM  
**Date Check/By:**  
**Other:**

<table>
<thead>
<tr>
<th>LAB #</th>
<th>Temp °C</th>
<th>Wt of Soil</th>
<th>Wt of Water Added</th>
<th>% Moist</th>
<th>Nat or Sat</th>
<th>Current Off</th>
<th>Current On</th>
<th>Resistivity (Ohm/cm)</th>
<th>Adjusted Resistivity R @ 15.5 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>7812</td>
<td>18.5</td>
<td>447.9</td>
<td>0.0</td>
<td>19.5%</td>
<td>N</td>
<td>0</td>
<td>0</td>
<td>10180</td>
<td>5.61 1815 1950</td>
</tr>
<tr>
<td>7812</td>
<td>18.5</td>
<td>541.5</td>
<td>225.3</td>
<td>41.6%</td>
<td>S</td>
<td>24.7</td>
<td>0</td>
<td>10240</td>
<td>6.8 1500 1615</td>
</tr>
</tbody>
</table>

Adjusted R = Rt*[(24.5+T)/40]

### Comments:

_____________________________
_____________________________
_____________________________
_____________________________

Craig Paulson  
Bozeman Materials Lab Manager  
1401 Gold Ave Unit B  
Bozeman, MT 59715
Preliminary Investigation
Laboratory Test Results
| LAB NUMBER | LOCATION | DEPTH RANGE | classification symbol | SMALLER THAN 0.075 mm | SAND NO. 200 (0.075 mm) TO NO. 4 (4.76 mm) | GRAVEL NO. 4 (4.76 mm) TO 3 IN (76.2 mm) | LIQUID LIMIT - % | PLASTICITY INDEX - % | MAXIMUM DRY UNIT WEIGHT (D698) - pcf | OPTIMUM MOISTURE CONTENT - % | CONSOLIDATION - Pc | CONSOLIDATION - Cc | CONSOLIDATION - Cs | UNCONFINED, q1 - KSF | UNCONFINED, q2 - KSF | UNIT WT. (CONSOL.) - DRY PCF | UNIT WT. (UNCONF.) - DRY PCF | UNIT WT. (TUBE) - DRY PCF | NATURAL MOISTURE - % |
|------------|----------|-------------|-----------------------|------------------------|------------------------------------------|-----------------------------------------|-----------------|-------------------|-------------------------------|-----------------------------|----------------|----------------|----------------|----------------|----------------|-----------------------------|----------------|----------------|----------------------|----------------------|
| 29897      | B-1      | 2.5'-4.5'   | CL                    |                        | 2.21                                     | 0.14                                    | 0.02            | 2.90              | 1.45                          | 103.1                       | 19.3           |                 |                 |                 |                 |                             |                |                |                      |                      |
| 7124       | B-1      | 2.0'-8.0'   | CL                    | 75.5                   | 24.5                                     | 35                                       | 19              | 97.0              | 22.2                          |                             |                 |                 |                 |                 |                 |                             |                |                |                      |                      |
| 29901      | B-3      | 5.0'-6.9'   | CL                    | 36                      | 13                                       |                                         |                 |                   |                              |                             |                |                 |                 |                 |                 |                             |                |                |                      |                      |
| 29904      | B-4      | 15.0'-17.0' | CL                    |                        | 2.99                                     | 0.09                                    | 0.02            | 2.27              | 1.14                          | 101.3                       | 21.1           |                 |                 |                 |                 |                             |                |                |                      |                      |
| 7125       | B-4      | 17.0'-18.5' | CL                    |                        | 35                                       | 19                                       |                 |                   |                              |                             |                |                 |                 |                 |                 |                             |                |                |                      |                      |
### CONSOLIDATION TEST REPORT

<table>
<thead>
<tr>
<th>Percent Strain (%)</th>
<th>Applied Pressure - ksf</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.0</td>
<td>0.1</td>
</tr>
<tr>
<td>10.5</td>
<td>1.0</td>
</tr>
<tr>
<td>9.0</td>
<td>10.0</td>
</tr>
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<td>12.0</td>
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<td>14.0</td>
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<td>24.0</td>
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#### MATERIAL DESCRIPTION

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<tr>
<th>Natural Sat.</th>
<th>Dry Dens. (pcf)</th>
<th>LL</th>
<th>PI</th>
<th>Sp. Gr.</th>
<th>Overburden (ksf)</th>
<th>P&lt;sub&gt;c&lt;/sub&gt; (ksf)</th>
<th>C&lt;sub&gt;c&lt;/sub&gt;</th>
<th>C&lt;sub&gt;s&lt;/sub&gt;</th>
<th>Swell Press. (ksf)</th>
<th>Clpse. %</th>
<th>e&lt;sub&gt;0&lt;/sub&gt;</th>
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</thead>
<tbody>
<tr>
<td>68.4 %</td>
<td>19.3 %</td>
<td>95.2</td>
<td>2.68</td>
<td>2.68</td>
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<td>0.14</td>
<td>0.02</td>
<td>0.1</td>
<td>0.757</td>
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</tr>
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</table>

#### MATERIAL DESCRIPTION

**USCS**

**AASHTO**

**Project No.:** 4522.11447.01  **Client:** A&E Architects

**Project:** MSU NAIC Engineering Building

**Location:** B-1 2.5-4.5’  **Depth:** 2.5-4.5’  **Sample Number:** 29897

**Remarks:**

Sample No. 29897

Sampled By: DOWL HKM

---

**Tested By:** _______________________  **Checked By:** MC
Particle Size Distribution Report

Test Results (ASTM D421 & ASTM D1140)

<table>
<thead>
<tr>
<th>Opening Size</th>
<th>Percent Finer</th>
<th>Spec.* (Percent)</th>
<th>Pass? (X=Fail)</th>
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</thead>
<tbody>
<tr>
<td>3/8 in.</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>99.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#20</td>
<td>97.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#40</td>
<td>94.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#80</td>
<td>88.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>86.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>75.5</td>
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</tr>
</tbody>
</table>

Material Description

lean clay with sand
BULK SAMPLE

Atterberg Limits (ASTM D 4318)

<table>
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<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>PL</td>
<td>16</td>
</tr>
<tr>
<td>LL</td>
<td>35</td>
</tr>
<tr>
<td>PI</td>
<td>19</td>
</tr>
</tbody>
</table>

Classification

USCS (D 2487) = CL
AASHTO (M 145) = A-6(13)

Coefficients

D_{90} = 0.2193
D_{85} = 0.1380
D_{60} =
D_{50} =
D_{30} =
D_{15} =
D_{10} =
C_{u} =
C_{c} =

Remarks

Date Received: 11/19/14  Date Tested: 11/21-25/14
Tested By: TJM
Checked By: CEP
Title: MANAGER, MATERIALS LAB

Date Sampled: 11/05/14

Location: B-1  Sample Number: 7124  Depth: 2'-8'

Client: A&E ARCHITECTS
Project: MSU NAIC ENGINEERING BUILDING
Project No: 4522.11447  Figure # 7124
Test specification: ASTM D 698-07 Method A Standard

<table>
<thead>
<tr>
<th>Elev/Depth</th>
<th>Classification</th>
<th>Nat. Moist.</th>
<th>Sp.G.</th>
<th>LL</th>
<th>PI</th>
<th>% &gt; #4</th>
<th>% &lt; No.200</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'-8'</td>
<td>CL</td>
<td>23.3</td>
<td>2.55</td>
<td>35</td>
<td>19</td>
<td>0.0</td>
<td>75.5</td>
</tr>
</tbody>
</table>

**TEST RESULTS**

Maximum dry density = 97.0 pcf

Optimum moisture = 22.2 %

**MATERIAL DESCRIPTION**

lean clay with sand
BULK SAMPLE

**Remarks:**

**Project No.** 4522.11447  **Client:** A&E ARCHITECTS
**Project:** MSU NAIC ENGINEERING BUILDING
**Date:** 11/24/14
**Location:** B-1  **Sample Number:** 7124

Tested By: TJM  Checked By: CEP
UNCONFINED COMPRESSION TEST

SAMPLE UNIT LOAD - KSF

<table>
<thead>
<tr>
<th>LAB NO.</th>
<th>RATIO</th>
<th>LOCATION</th>
<th>DEPTH</th>
<th>DATE TESTED</th>
<th>% MOISTURE</th>
<th>WET UNIT WT.</th>
<th>DRY UNIT WT.</th>
<th>U.C. STRENGTH, qu</th>
<th>COHESION (qu/2)</th>
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</thead>
<tbody>
<tr>
<td>29897</td>
<td>2.00</td>
<td>B-1</td>
<td>2.5-4.5'</td>
<td>11/225/14</td>
<td>19.8 %</td>
<td>123.5 PCF</td>
<td>103.1 PCF</td>
<td>2.90 KSF</td>
<td>1.45 KSF</td>
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<tr>
<td>29901</td>
<td>2.08</td>
<td>B-3</td>
<td>5.0-6.9'</td>
<td>11/25/14</td>
<td>21.3 %</td>
<td>118.9 PCF</td>
<td>98.0 PCF</td>
<td>2.01 KSF</td>
<td>1.01 KSF</td>
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<tr>
<td>29904</td>
<td>1.39</td>
<td>B-4</td>
<td>15.0-17.0'</td>
<td>11/25/14</td>
<td>21.5 %</td>
<td>123.0 PCF</td>
<td>101.3 PCF</td>
<td>2.27 KSF</td>
<td>1.14 KSF</td>
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</tbody>
</table>

PROJECT: MSU NAIC
PROJECT NO.: 4522.11447.01
SAMPLED BY: DOWL HKM
DATE SAMPLED: 11/3/2014

DOWL HKM
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils.

WATER CONTENT

NUMBER OF BLOWS

MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Project No.</th>
<th>4522.11447</th>
<th>Client: A&amp;E ARCHITECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project:</td>
<td>MSU NAIC ENGINEERING BUILDING</td>
<td></td>
</tr>
<tr>
<td>Location:</td>
<td>B-1</td>
<td></td>
</tr>
<tr>
<td>Sample Number:</td>
<td>7124</td>
<td></td>
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<tr>
<td>Depth:</td>
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<td></td>
</tr>
<tr>
<td>Remarks:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

lean clay with sand
BULK SAMPLE

<table>
<thead>
<tr>
<th>LL</th>
<th>PL</th>
<th>PI</th>
<th>%&lt;#40</th>
<th>%&lt;#200</th>
<th>USCS</th>
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</thead>
<tbody>
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<td>35</td>
<td>16</td>
<td>19</td>
<td>94.4</td>
<td>75.5</td>
<td>CL</td>
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Figure # 7124B
CONSOLIDATION TEST REPORT

Percent Strain

Applied Pressure - ksf

Water Added

<table>
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<th></th>
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<th></th>
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<tbody>
<tr>
<td>82.5 %</td>
<td>26.5 %</td>
<td>89.9</td>
<td>36</td>
<td>13</td>
<td>2.68</td>
<td>0.534</td>
<td>2.77</td>
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<td>0.02</td>
<td>0.0</td>
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MATERIAL DESCRIPTION

USCS
AASHTO

Remarks:

Sample No. 29901
Sampled By: DOWL HKM

Tested By: _______________________________  Checked By: MC _______________________________
CONSOLIDATION TEST REPORT

<table>
<thead>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>77.5 %</td>
<td>21.1 %</td>
<td>96.6</td>
<td></td>
<td></td>
<td>2.68</td>
<td>1.546</td>
<td>2.99</td>
<td>0.09</td>
<td>0.02</td>
<td>1.60</td>
<td>0.2</td>
<td>0.732</td>
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MATERIAL DESCRIPTION

<table>
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<th>AASHTO</th>
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**Project No.:** 4522.11447.01  **Client:** A&E Architects

**Project:** MSU NAIC Engineering Building  **Remarks:**
Sample No.29904  Sampled By: DOWL HKM

**Location:** B-4 15.0-17.0’  **Depth:** 15.0-17.0’  **Sample Number:** 29904

**Figure 03**

**Tested By:**                         **Checked By:** MC
LIQUID AND PLASTIC LIMITS TEST REPORT

Dashed line indicates the approximate upper limit boundary for natural soils.

MATERIAL DESCRIPTION | LL | PL | PI | %<40 | %<200 | USCS
--- | --- | --- | --- | --- | --- | ---
STP | 35 | 16 | 19 | | | 

Project No. 4522.11447  Client: A&E ARCHITECTS
Project: MSU NAIC ENGINEERING BUILDING
Location: B-4
Sample Number: 7125  Depth: 17'-18.5'

Remarks:

Figure # 7125B
Appendix C

Photographs
Boring B-1 – View Southwest – Southwest Corner of Parking Garage

Boring B-1 – View Northwest – Southwest Corner of Parking Garage
Boring B-2 – View Northwest – Northwest Corner of Innovation Center Site

Boring B-2 – View Northeast – Northwest Corner of Innovation Center Site
Boring B-3 – View Northeast – South Central Portion of Innovation Center

Boring B-3 – View Northwest – South Central Portion of Innovation Center
Boring B-4 – View North – Northeast Corner of Innovation Center

Boring B-4 – View South – Northeast Corner of Innovation Center
Appendix D

Screw Pile Information
Greg,

Thanks for contacting Alpine Site Services about using our screw pile foundation system as an alternate for the MSU Innovation Center project in Bozeman, MT. We appreciate your interest and do feel our system will work very well (again) for the project site soils and expected loads. As you remembered, Alpine does provide a thorough package documenting our piles and conducts load testing on all projects to ASTM standards.

I’ve attached our engineer’s letter from the Gallatin Co. Detention Center project in ’09 showing that our screw piles achieved 140kip compressive service loads, along with an almost 20kip lateral load (when installed with the concrete cap specified), with a safety factor of 2 and 2.6 respectively. Also, I’ve attached our Alpine brochure and some other information as you requested. As you said, screw piles would be a viable foundation given the lighter sand layers involved here, with the strong advantages of faster installation and verified loading provided by our load testing.

Alpine has completed several large parking garage structures throughout the Rocky Mountain region, including one in Jackson Hole, WY and one in Glenwood Springs, CO. Our screw pile system has proven capabilities on commercial, educational and industrial projects for over 12 years in all kinds of soils conditions, and with strict loading parameters. In fact, we’ve completed 6 major buildings for the Mesa State campus in Grand Junction, CO and many other private and public educational buildings in Colorado.

Thanks again for your interest and for thinking of Alpine for this project. Please contact me with any requests for further information, and please let us know about this project moving forward. I’ll be sure and keep in touch with Martel Construction, as it was a pleasure working with them on the detention center project.

Mike Oliveira
(303) 994-3131 mobile

Alpine Site Services
10875 Dover Street, Suite 1100
Westminster, CO 80021
(303) 420-0048 office
ADVANTAGES

Save Valuable Time

- Engineered Screwpiles are four times faster than drilled piers, caissons, and driven piles. With multiple machines, reduce your installation time even further.
- Because our machines easily access difficult sites and require far less space during installation than other methods, the rest of the site can be working at the same time.
- Our Screwpiles work in virtually any weather. Your site keeps working while others are having a “snow day.”

Control Cost & Save Money

- All the costs for our Engineered Screwpiles are presented up-front. Prices won’t change after the job is completed. You won’t experience “sticker shock” over post completion charges for extra length, casing or rock.
- Because of their design and installation process, Engineered Screwpiles will always save you money over other deep foundation systems.

Proven Reliability

- Alpine’s Engineered Screwpiles are load tested for verified performance you can rely on.
- Our patent pending torque monitoring system ensures consistency during installation.
- Throughout the process, data and charting output is provided for engineer’s verification and review.

Simple Change-Over

- Pre-engineered details/drawings make change-over a snap with rapid turn around on custom detailing and designs.

WHEN SHOULD YOU USE ENGINEERED SCREWPILES

IF THE OVER-EXCAVATION DEPTH IS GREATER THAN 3’

IF THE BEARING PSF IS 2500 OR LESS

WHEN THE EXPECTED CAISSON, DRILLED PIER OR DRIVEN PILE DEPTH IS GREATER THAN 20’

FOR DENSE MATERIAL OR SOIL, STONE, COBBLE AND BOULDERS
engineered screwpiles

for more information on engineered screwpiles

contact bernie gochis at 303.420.0048 • email: bgochis@alpinesites.com

or write

5990 kipling parkway • suite 001 • arvada, colorado 80004

save time & cost overruns on your next project

engineered screwpiling
Typical Steps to Screwpile Engineering Integration

Structural Engineer of Record responsibilities:
1. Provide all project loading information (axial, tension and lateral loads)
2. Provide background drawings for Screwpile engineer to design pile layout
3. Coordinate pile location placement, with assistance from Screwpile Engineer
4. Review Screwpile shop drawings and Load Test provided by Alpine

Geotechnical Engineer responsibilities:
1. Provide Soils Report (Borings), consult with Alpine on difficult sites
2. Observe Pile characteristics and Load Testing
3. Inspect Installs for Depth & Torque, provide inspection logs

Screwpile Engineer responsibilities:
1. Design Pile & Pile Connection
2. Design Pile Layout
3. Review Load Test & Determine torque requirements
4. Review install logs & write project completion documents
March 6, 2009

Attn: Bernie Gochis
Alpine Site Services
5990 Kipling Parkway, Suite 001
Arvada, CO 80004

Re: Gallatin County Detention Center Lateral Load Test
Bozeman, MT
AEI Project #080251

Test Date: March 4, 2009

Dear Mr. Gochis,

At your request, a representative from our office has observed an in situ lateral load test and reviewed the results to verify that the intended pile and pile cap design is appropriate for the site. The test was performed using a built up assembly anchored with a single vertical pile and a single battered pile tied together with a steel plate and a high capacity hydraulic load cell to apply lateral load to the test pile and pile cap. The test generally followed the requirements of ASTM D1143.

The purpose of our test was to determine if the pile, pile cap, and backfill material will have sufficient lateral capacity to resist a seismic lateral load of 18,000 pounds as specified by the project Engineer of Record. A test pile, comprised of a single five and one-half inch outside diameter screw pile, 0.360 inch wall thickness, and two ¾ inch thick helices, was installed to a depth of 19'-0" from existing grade. The first helix was 12" in diameter and located approximately six inches from the tip of the pile. The second helix was 14" in diameter and located approximately 1'-4" above the first helix. The installation torque achieved at bearing depth was approximately 49,000 lb-ft. A 3'-4"x3'-4"x3'-0" deep concrete cap reinforced as indicated on the project documents was placed with the test pile cap plate embedded 6 inches into the base per the preliminary shop drawings provided by our office and cured to a final tested compression strength of approximately 3,200 psi. Backfill material was placed around the test assembly and compacted in 6 inch lifts as required for the site backfill per the geotechnical recommendations to a height approximately equal to the top of the concrete pile cap.

A lateral design load of 18,000 pounds was applied with a recorded deflection of 0.021 inches after a load rest duration of fifteen minutes. The loading was then increased to a load of 42,000 pounds with an additional load rest duration time of ten minutes where a relaxation occurred to a final proof load of 40,800 pounds with an associated final measured deflection of 0.071 inches. In the hope of determining a failure point, the lateral force was increased to a maximum load of 50,000 pounds. Over the course of a 22 minute loading rest, a relaxation of approximately 3,000 pounds occurred to a minimum maintained load of 47,000 pounds with an associated total final deflection of 0.113 inches. Although no failure was observed and the service level deflection limit had still not been reached, the load test was concluded. The pile and pile cap assembly rebounded as the test load was released to a deflection of 0.062 under zero load, indicating that the pile behaved in a linear elastic manner, with an acceptable total lateral movement. It is likely the remaining deflection is due to the friction force between the concrete cap and surrounding soil at this deflection point had become greater than the force exerted by the pile shaft returning to the original un-deflected shape.

This test established that the pile and pile cap foundation system will have sufficient lateral capacity with the controlled structural fill specified in the geotechnical report to resist the seismic lateral loading provided by the Engineer of Record. Although a deflection limit of 3/8 inch was set for the service level load of 18,000 pounds, this deflection was not achieved even at an ultimate proof load of 47,000 pounds. Based on the lateral load test
information detailed above, the pile and concrete pile cap are sufficient to provide 18,000 pounds of lateral resistance with negligible deflection and a minimum safety factor of 2.6. Piles shall be placed such that there is adequate concrete cover provided (2” minimum), and no more than 3” out of dimensioned location. Piles placed singly, or in pairs, such that they support a discrete column load, shall be evaluated on a case-by-case basis considering the actual service load so that an allowable tolerance may be established.

**Pile Material Test Specimens:**

Pile test samples will be taken from the pile fabrication yard at Alpine Site Services, as well as from the project site during installation. The samples are to be collected and delivered to a material testing company for testing. The pile sections will be tested to verify the structural properties of the pipe material. For the 140 kip pile, the minimum $f_y$ for the steel must meet or exceed 70 ksi, and the minimum nominal material thickness must be 0.360 inches for the pipe shaft wall thickness. Samples shall be taken for testing from the site at the rate of one sample per 200 sections or portions thereof of piling installed.

**Installation Torque Logs:**

Installation Torque Logs will be reviewed as they become available during production pile installation. Review of the logs will verify that minimum required torques per the compression load test documentation were achieved, and/or that satisfactory steps were taken to correct any piers that did not achieve specified torque. Special Inspection reports provided by the geotechnical engineer will also be reviewed to verify that minimum installation depths are achieved, or that acceptance was provided for any piers that did not meet the minimum depth requirement.

Should questions arise, or if further information is required, please contact our office.

Sincerely,

Anchor Engineering & Inspection, Inc.

Reviewed by,

Richard M. Schauppner, P.E.  Eric A. Hanson, P.E.
Project Manager  Principal