BID PROPOSAL
AND SPECIFICATIONS

FOR

PERE MARQUETTE SOUTH RESTROOM

FOR

City of Muskegon

JULY, 2024

Prepared By:

MCSA GROUP, Inc.
Landscape Architects and Architects
EAST GRAND RAPIDS • MICHIGAN

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INVITATION TO BID

Sealed proposals for Pere Marquette South Restroom Building in Muskegon, Michigan will be received at the office of Mr. Dan VanderHeide, 1250 E. Keating Ave. Muskegon, Michigan, 49442 until Tuesday, August 20, 2024, at 2 p.m.. local time, at which time all bids will be publicly opened and read aloud.

The work generally involves improvements to Pere Marquette South Restroom Building. Specific items include installation of a new restroom building and renovation of the existing "kite shack." Furthermore, proposed activities include site preparation inclusive of rough and finish grading, general removal items including the removal of existing concrete paving and bituminous paving, concrete paving, bituminous paving, sheet pile wall, restroom utilities, an ADA shower, and lawn seeding.

This project is partially funded by the Michigan Natural Resources Trust Fund and relevant State or Federal requirements apply. Contractor and all subcontractors must comply with all requirements of 1976 PA 453 (ElliottLarsen Civil Rights Act), the 1976 PA 220 (Persons with Disabilities Civil Rights Act), and Executive Directive 201909, as amended. In accordance with these laws, all contracts the grantee enters into must contain a covenant by the contractor and any subcontractors not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of race, color, religion, national origin, age, sex, height, weight, marital status, partisan considerations, or a disability or genetic information that is unrelated to the individual's ability to perform the duties of a particular job or position.

Bid documents will be available for examination at the Builder's Exchange of Grand Rapids, 678 Front Ave N.W. Ste 300, Grand Rapids, Michigan 49506, or website at www.grbx.com, and at Dodge Data & Analytics website at www.contruction.com. Bid documents will also be available for distribution only at M. C. Smith Associates and Architectural Group, Inc., 529 Greenwood Avenue S.E., East Grand Rapids, Michigan 49506 between the hours of 8:30 a.m. and 4:30 p.m. weekdays.

A non-refundable charge of Thirty Dollars ($30.00) will be required for each bid set picked up at MCSA Group, Inc. An additional non-refundable charge of Fifteen Dollars ($15.00) will be charged for UPS ground shipping or an additional non-refundable charge of Twenty Dollars ($20.00) will be charged for UPS overnight shipping. Digital copies of the bid set are also available by email or CD for a non-refundable charge of twenty dollars ($20.00).

Proposals must be accompanied by a certified check, bank draft of bid bond of an approved surety company doing business in Michigan in an amount equal to five percent (5%) of the total amount proposed. Proposals shall be submitted in accordance with the Information for Bidders of the bid documents.

The Owner reserves the right to reject any or all bids or any parts of the same, waive any irregularities, and to accept any bid in their own best interest.

Bid documents will be available starting July 22, 2024
Project Start Date: September 9, 2024
Project Completion Date: April 25, 2025

MCSA Group, Inc. (M. C. Smith Associates and Architectural Group, Inc.)
529 Greenwood Avenue S.E.
East Grand Rapids, Michigan 49506
Phone: (616) 451-3346 / Fax: (616) 451-3295
Tiffany Smith
tas@mcsagroup.com

INFORMATION FOR BIDDERS

1.00 **SUBMISSION OF BIDS**:

Bid Proposals shall be submitted to the specified person or place in accordance with the Invitation to Bid. The opening shall be public or private as stipulated. Bid Proposals submitted after the time set for the opening to proceed has passed shall be returned to the Bidder unopened or shall be given discretionary consideration as determined to be in the best interest of the Owner.

2.00 **BID DOCUMENT PROCUREMENT**:

Bid Documents may be obtained or examined at the locations and hours listed in the Invitation to Bid. A non-refundable charge in the amount listed in the Invitation to Bid will be required for each bid set received. Bid sets requiring special handling or shipping will have an additional non-refundable charge in the amount listed in the Invitation to Bid.

3.00 **FAMILIARIZATION WITH WORK**:

Bidders shall be responsible for completely familiarizing themselves with the extent and nature of the work by thoroughly examining the site, plans, specifications and proposal and evaluating the quantities and types of labor, equipment and materials necessary to complete the work.

4.00 **COMPLETION OF PROPOSAL FORM**:

The bid must be itemized upon the blank Form of Proposal annexed hereto and shall give the price for the items of the work required as shown on the drawings or elsewhere both in writing and in figures, in ink, and be signed by the bidder with his business address and telephone number. Alteration of the Proposal in any way, inclusion of unsolicited items, failure to comply with the specified procedures for bidding or any other irregularity shall be adequate grounds for rejection of the bid proposal.

5.00 **SUBMISSION OF BID PROPOSAL**:

Submit Bid Proposal and Security in an opaque, sealed envelope clearly identified with: 1) project name 2) description of the work 3) name and address of bidder and in accordance with the Invitation to Bid.

6.00 **BID SECURITY**:

Bids must be accompanied, in the sealed envelope, by a bid bond or certified check payable to the designated Owner in the amount of five percent (5%) of the total amount bid, drawn on a Michigan Bank, which shall be retained by the Owner if the successful bidder does not enter into a Contract for the work nor provide good and sufficient Performance Bond and Insurance Certificates on the specified date as liquidated damages, but not as a penalty.

The bid bonds of unsuccessful bidders shall be returned within three (3) days after

award of the Contract.

7.00 **PROOF OF RESOURCES**:

Bidders may, at the discretion of the Landscape Architect, be required to show that they have the necessary capital, material, equipment and facilities to completely perform all of the proposed work in a good workmanlike manner.

8.00 **PROPOSAL WITHDRAWAL**:

Proposals may be withdrawn at any time previous to the hour of opening bids. Bid proposals are irrevocable for a period of seventy-five (75) days from the date of the bid opening.

9.00 **KNOWLEDGE OF REGULATIONS**:

Each bidder must familiarize himself with and conform to all laws, ordinances and codes that might affect the proposed work in any way and shall pay for all permits, fees and licenses necessary to perform this work.

10.00 **QUALIFICATION STATEMENT**:

The bid will be awarded to the lowest qualified bidder.

Each bidder must complete the qualification statement included with the proposal form section. This statement requires identification of all subcontractors who must also complete a copy of this form to be submitted with bid proposals.

11.00 **PERFORMANCE SURETY AND INSURANCE**:

Prior to execution of the contract by the Owner, the successful bidder must execute a Performance Bond and Labor and Material Bond on the proper form with a corporate surety qualified to do business in the State of Michigan, acceptable to the Owner and acceptable as surety on bonds in favor of the United States, in the amount of 100% of the total bid amount. The surety's agent who executed the bond must be located and doing business in the State of Michigan, and such agent must affix his power-of-attorney to the bond. The Contractor must also furnish to the Owner prior to execution of the contract, a certificate issued by the insurer certifying that he is covered by Worker's Compensation insurance against public liability and property damage, in amounts equal to that specified in the General Conditions.

12.00 **ADDITIONAL INFORMATION**:

Additional information about the project is available from M. C. Smith Associates and Architectural Group, Inc., 529 Greenwood Avenue, S.E., East Grand Rapids, Michigan 49506. Phone: (616) 451-3346 / Fax: (616) 451-1935.

13.00 **SUCCESSFUL BIDDER NOTIFICATION**:

The successful bidder will be notified following approval of the bid proposal by the Owner and is to execute the contract, complete with performance sureties and insurance certificates, within 10 days of notifications of award of the Contract.

14.00 **COMMENCEMENT OF WORK**:

The Contractor shall begin the work within five (5) days after execution of the contract or as weather permits and shall proceed in an expeditious and professional manner with the highest quality material and workmanship.

15.00 **INSPECTION NOTIFICATION**:

The Landscape Architect is available within forty-eight hours (48) after notice for on-site inspections.

16.00 **PRE-CONSTRUCTION CONFERENCE**:

A pre-construction meeting may be held prior to commencement of the work to review items of work and establish a sequence and timetable for the execution of the work.

17.00 **ERRORS AND OMISSIONS**:

Bidders shall immediately notify the Landscape Architect of any errors, omissions or discrepancy in the bid documents so they and other bidders can be advised of an acceptable bid procedure.

18.00 **LUMP SUM BID**:

This is a lump sum bid. Bids as submitted are for complete quantities as shown by the plans and no adjustments will be made once construction begins. Bidders are responsible for complete construction based upon bids submitted.

19.00 **COMPLETION OF WORK**:

All work, including substantial completion of all items under this contract, including clean-up and punch list items shall be performed in the prescribed manner and completely executed ready for use by date for all construction items.

21.00 **PLANS FOR CONSTRUCTION**:

Prior to construction the successful contractor will be provided two complete sets of construction plans and specifications. Additional sets of plans may be purchased from the landscape architect at their current schedule of rates for printing and binding of these plans and specifications.

GENERAL CONDITIONS

1.00 **TERMS DEFINED**:

Wherever in the bid or contract documents the term "LANDSCAPE ARCHITECT" appears, it shall refer to M. C. Smith Associates and Architectural Group, Inc., Landscape Architects and Architects, or his authorized representative. Wherever the term "OWNER" is used, it shall refer to the City of Muskegon as "Party of the First Part" in the Proposal Agreement and Contract. The term "CONTRACTOR" shall refer to the "Party of the Second Part" in the Proposal Agreement and Contract.

2.00 **BOND**:

The Contractor shall, at the time of the execution and delivery of the contract and before the taking effect of the same in other respects, furnish and deliver to the Owner a written bond or indemnity to the amount of One Hundred Percent (100%) of the total base price of this contract which is herein stated, in form and substance and with surety thereon satisfactory and acceptable to the Owner, to insure the faithful performance of the Contractor of all the covenants and agreements on the part of the Contractor contained in this contract, or any part thereof, and for the period of extension that may be granted on the part of the Owner as well as for all changes, and modifications of the contract as herein provided, for the prompt payment of all laborers, tradesmen, mechanics, subcontractors for materials, supplies or provisions for carrying on such work, and all just dues and demands incurred in the performance of the work, and to indemnify and save harmless the Owner against any direct or indirect damages that may be suffered or claimed or from injuries to persons or property during the construction of said work until it is accepted, and against claims or royalties on patents and to indemnify and save the Owner harmless from all losses, costs and expenses which it may sustain by reason of any negligence of the Contractor.

3.00 **CONTRACTOR'S UNDERSTANDING**:

It is understood and agreed that the Contractor has, by careful examination satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the character of the equipment and facilities needed preliminary to and during the prosecution of the work, the general and special conditions, and all other matters which can in any way affect the work under the contract. No verbal agreement or conversation with any officer, agent or employee of the Owner, either before or after the execution of this contract shall affect or modify any of the terms or obligations herein contained.

4.00 **SUBSTITUTIONS**:

Each bid or proposal shall be based upon the materials and equipment described in the bidding documents. Whenever a material, article or piece of equipment is identified on the Drawings or in these specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, or the like, it is so identified for the purpose of establishing a standard, and any material, article, or piece of equipment of other manufacturers or vendors which will perform comprehensively the duties imposed by

the general design will be considered equivalent provided the material, article, or piece of equipment so proposed is, in the opinion of the Landscape Architect, equivalent in substance, appearance and function.

No substitution will be considered unless written request has been submitted to the Landscape Architect for approval at least seven (7) days prior to the date of receipt of bids. Each such request shall include a complete description of the proposed substitute, the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. A bidder requesting approval of a substitute shall also promptly submit additional data requested by the Landscape Architect. Only approvals embodied in a written Addendum shall be binding.

Substitutions submitted after bid date will be reviewed for compliance with Construction Documents for a Review Fee (to be charged to the Prime Contractor) as follows:

A. A minimum review fee of $250.00 for reviewing and processing non-specified items will be charged to Prime Contractor. Request must be submitted in writing to the Landscape Architect with fee attached.

B. If review time exceeds $250.00 minimum charge, the additional time will be billed at an hourly rate of $100.00 per hour to be paid before Landscape Architect renders decision.

5.00 **APPROVED EQUAL**:

References to the term "equal" or "approved equal" shall mean that alternate or substitute items shall be equal to or greater in every respect than the item specified. All such substitutions shall be proposed to the Landscape Architect in writing prior to bidding. The Contractor shall receive written notice of approval prior to committing himself in any way to the item. The Contractor will be proceeding at his own risk in the absence of a written approval and shall be fully responsible for all removal, replacement and restoration necessary to conform to the Contract and shall incur all costs directly or indirectly related to such activities.

6.00 **PERMITS**:

The Contractor shall be responsible for the procurement of and payment for all permits, and licenses necessary for the complete prosecution of the work.

7.00 **PROTECTION**:

Whenever the local conditions, circumstances, laws or ordinances require, the Contractor shall furnish and maintain, at his own expense and cost, necessary passageways, barriers, lights and such facilities and means of protection as may be required to provide safe conditions at all times.

8.00 **RIGHTS OF VARIOUS INTERESTS**:

Whenever work being done by Owner's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Landscape Architect to secure the completion of the various portions of the work in general harmony.

9.00 **CONSENT TO TRANSFER**:

The Contractor shall not let or transfer this contract or any part thereof (except for the delivery of material) without the written consent of the Landscape Architect. Such consent does not release or relieve the Contractor from any of his obligations and liabilities under this Contract.

10.00 **SUPERINTENDENCE**:

The Contractor shall constantly supervise all the work embraced in this contract in person or by a duly authorized manager acceptable to the Landscape Architect.

11.00 **TIMELY DEMAND FOR INSTRUCTIONS**:

The Contractor shall provide reasonable and necessary opportunities and facilities for review. He shall not proceed until he has made timely demand upon the Landscape Architect for, and received from him, such instructions as may be necessary as the work progresses. The work shall be done in strict conformity with such instruction. The Contractor shall furnish the Landscape Architect, from his force, sufficient and competent help for any field work in connection with the project which the Landscape Architect may require. The Contractor shall employ diligence and care in protecting all points and stakes approved by the Landscape Architect. The Contractor shall be responsible also for the failure to follow stakes given him by the Landscape Architect as well as failure to conform to other directions or instructions of the Landscape Architect, and shall rectify any work which does not conform to the Landscape Architect's directions, at his own expense.

12.00 **REPORT ERRORS AND DISCREPANCIES**:

If the Contractor, in the course of the work, finds any discrepancy between the plans and the physical conditions of the locality or any errors or omissions in plans or in the layout as given by said instructions, it shall be his duty to immediately inform the Landscape Architect, in writing, and the Landscape Architect shall promptly verify the same. Any work done after such discovery, until authorized, will be done at the Contractor's risk.

13.00 **COMPLIANCE:**

All construction shall conform to all aspects of the State of Michigan Building Code (MBC), Uniform Federal Accessibility Standards (UFAS), the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) and the Americans with Disabilities Act (ADA). All work by the Contractor for complete execution of this project shall meet

or exceed laws, guidelines, and statutes in every situation. In the event the Contractor believes that any portion of the work is inconsistent with the MBC, UFAS, ADAAG, and ADA they must immediately inform the Landscape Architect.

14.00 **INSPECTIONS**:

All work and materials shall be open to the inspection, acceptance and rejection of the Landscape Architect or his duly authorized representative at all times. The Contractor shall give the Landscape Architect reasonable and necessary facilities for inspection, even to the extent of taking out portions of finished work, if the work is found satisfactory, the cost of taking out and replacement will be paid by the Owner.

15.00 **DEFECTIVE WORK OR MATERIALS**:

The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his contract as herein prescribed, and defective work shall be made good and unsuitable materials may be rejected, notwithstanding that such work and materials have been previously overlooked by the Owner and accepted or estimated for payment. If the work or any part thereof shall be found defective before the final acceptance of the work, the Contractor shall forthwith make good such defect, without compensation, in a manner satisfactory to the Landscape Architect as unsuitable or not in conformity with the specifications, the Contractor shall forthwith remove them from the site. If the Contractor shall fail to replace any defective work or materials after reasonable notice, the Landscape Architect may cause such defective work or materials to be replaced and the expense thereof shall be deducted from the amount to be paid the Contractor. It is further expressly agreed that the granting of any progress certificate, the signing of any periodic estimate, or the payment of any money hereunder shall not be considered an acceptance of all or part of the work and shall in no way lessen the liability of the Contractor to replace defective work, though the same may not have been detected prior to the time that such money was paid. All periodic estimates are to be made merely on approximate quantities and shall be subject to correction at the time or before final estimate or final payment is made. However, nothing in this Contract shall be construed to mean that the Owner or its Landscape Architect waivers or forfeits any right it or he has or had to later complain about defective materials or workmanship.

16.00 **INDEMNITY**:

The Contractor shall defend, indemnify, protect and save harmless the Owner, its Landscape Architect and their officers and agents, from all suits or claims of every name or description brought against the Owner or its officers and/or agents for or on account of any loss, injuries or damages to persons or property received or sustained by any person or persons, or from the Contractor, his servants or agents in or on account of work done under the contract or extensions of, or additions thereto, whether caused by negligence or in consequence of any negligence in guarding the same, or by or account of any improper materials used in its construction or by or on account of any accident or of any acts of omission of the Contractor, his servants or agents; and Contractor further agrees that so much of the money due to him under this agreement as shall be considered necessary by the Owner, may be retained until all such suits or claims for damages

aforesaid have been settled, and evidence to that effect has been furnished to the satisfaction of the Owner. This covenant of indemnification shall include reasonable costs and attorney fees incurred in defense of such claim, action, or liability.

17.00 **SETTLEMENT FOR WAGES AND MATERIALS**:

If at any time during the progress of said work, said Contractor shall fail or neglect to pay for any labor performed, transportation charges, materials furnished, or tools, machinery, appliances, fuel, provisions or supplies of any sort or kind used or consumed in, upon, or on account of said work, for ten (10) days after payment for same shall become due, then the Owner shall have the power to pay for such labor, or for such transportation charges, materials, tools, machinery, appliances, fuel, provisions or supplies, and the amount so paid shall be retained out of the money due or to become due to said Contractor, and said Owner may refuse to make the payment hereinafter mentioned to the extent of such indebtedness until satisfactory evidence in writing has been furnished and said indebtedness has been discharged. In any case, said Owner is hereby authorized and empowered by said Contractor to ascertain by the Landscape Architect the amount due or owing from said Contractor, to any laborer, or laborers, or to any person or persons or corporations for labor, transportation charges, materials, tools, machinery, appliances, fuel, provisions or supplies of any sort or kind used or consumed upon, in or on account of work covered by this Contract in such manner upon such proof as the Landscape Architect may deem sufficient.

18.00 **RISK**:

The Contractor shall take all responsibility of the work and shall bear all losses resulting to him on account of the amount and character of the work, because the nature of the land in or upon which the work is done is different from what is assumed or expected or on account of the weather, floods, or other causes.

19.00 **ORDER AND DISCIPLINE**:

The Contractor shall at all times enforce strict discipline and good order among his employees, and any superintendent, foreman or other employee of the Contractor who shall appear to be incompetent, disorderly, or in any way disqualified or unfaithful to the work entrusted to him, or whom the Landscape Architect may consider prejudicial to the prosecution of the work, shall be discharged immediately upon the request of the Landscape Architect, and shall not again be employed on the work without the Landscape Architect's written consent.

20.00 **CLEANUP**:

The Contractor, on completion of the work, or significant parts thereof, shall put the site in a clean, orderly, usable manner free of construction debris, temporary structures, unnecessary materials or equipment, irregularities in ground grades or other project related conditions. The cost of such clean-up and removal shall be part of the Contract and shall in no way entitle the Contractor to additional fees or payments. Final or partial payments and execution of the Certificate of Substantial Completion will be withheld until such items are completed to the satisfaction of the Landscape Architect.

21.00 **AUTHORITY OF LANDSCAPE ARCHITECT**:

The Landscape Architect shall have the authority to reject or condemn all work or materials which does not conform to his contract; to direct application of forces to any portion of the work, which, in his judgement requires it; to order forces increased or diminished, and to decide questions which arise between the parties relative to the execution of the work. All questions or controversies which may arise between the Contractor and Owner under or in reference to this Contract shall be subject to the decision of the Landscape Architect, and his decision shall be final and conclusive upon both parties, except in cases where time and/or financial considerations are involved; which, if no agreement in regard thereto is reached, shall be subject to arbitration.

22.00 **AUTHORITY OF OWNER**:

The Owner shall advise the Landscape Architect of changes in their financial capability, changes in their understanding of the intent of the plans, concerns for progress or quality of the work or of any other comment or concern related to the work in any way. The Owner shall not directly administer alterations to the work nor direct or supervise any employee or representative of the Contractor in any way at any time without the written consent of the Landscape Architect to both parties.

23.00 **UNCLASSIFIED WORK**:

In case any work shall be required to be furnished whether specified herein or indicated on the plans or not, or whether or not such work is typical work listed in the proposal which is in the opinion of the Landscape Architect, not susceptible of classification under the Schedule of Unit Prices, the Contractor shall and will, if ordered by the Owner, do and perform such work and furnish such materials as may be required. If possible, an agreement as to the cost and payment for said additional work will be reached and agreed upon by the Owner and Contractor. In the event of failure to reach such satisfactory agreement, the Contractor may be ordered by the Owner to proceed with such work and furnish such materials on a cost plus basis, on which basis the contractor shall receive the cost of any materials which he may be required to purchase plus ten percent (10%) and the cost of any labor which may be required to supply plus fifteen percent (15%). The ten percent (10%) and fifteen percent (15%) of such net cost are for profit, the use of the plant, tools, superintendence, overhead costs, and all other expenses incidental to the performance of such work and the furnishing of such materials, and the Contractor shall have no further claim in excess of the above; but this method of payment shall not apply to the performance of any work or the furnishing of any materials which, in part or in whole, is in the opinion of the Landscape Architect, susceptible of classification under such schedule which work or material shall be paid for in part or in whole as the case may be, at the Unit Price given in such schedule, except as herein otherwise expressly provided.

In case any work or material is required to be done or furnished under the provisions of this article for cost plus ten percent (10%) and fifteen percent (15%) as stipulated above, the Contractor shall at the end of each day, during the progress thereof, furnish to the Landscape Architect daily time slips showing the name and/or number of each workman employed thereon, the character of work his workmen are doing the wage paid or to be

paid to therefore. If required, the Contractor shall produce any books, vouchers, records or memoranda showing the work and materials actually paid for the actual prices therefore. Such daily time slips and memoranda shall not, however, be binding upon the Owner and if any question or dispute shall arise as to the correct cost of such work or material, the determination of the Landscape Architect upon such question or dispute shall be final and conclusive.

24.00 **CHANGES**:

The Landscape Architect shall have the right to increase or diminish all or any contract amount or items without impairing the volume or scope of this contract so long as these alterations do not change the amount of the contract price more than 35%.
Decreases in the quantity of work by more than 35% does not constitute a claim for damage or for loss of profits on the work to be dispensed with. Such alterations shall not in any way release or impair the bond or the sureties nor will any payments be made for items of work not actually constructed, regardless of the quantities shown in the bid and contract documents.

25.00 **UNAVOIDABLE DELAYS - EXTENSION OF TIME**:

If the Contractor shall be delayed in the performance of the work from any natural or unavoidable cause or for which the Owner or his authorized representative is responsible, he shall, upon written application to the Landscape Architect at the time of such delay, be granted such extension of time as the Landscape Architect shall deem equitable and just.

26.00 **SUSPENSION OF WORK**:

Should the Landscape Architect deem it necessary to suspend operations on the work due to severity of the weather, he may notify the Contractor in writing to suspend operations on the entire project or any part thereof, and in the event of such right being exercised, the Landscape Architect shall grant to the Contractor an extension of the work. The Contractor shall on not less than ten (10) days notice, again resume the work if ordered to do so by the Landscape Architect. The Owner shall also reserve the right to suspend operations for any reason that it may deem necessary for a period not longer than ten (10) days, at any one time in which event the Contractor will be allowed an extension of time equivalent to the time that the work has been suspended. Should such a suspension be deemed necessary by the Owner, the Contractor shall have no claim for damage due to such suspension.

27.00 **EXPEDITING WORK**:

(A) **Correcting Imperfections**: If the Landscape Architect or the Owner shall at any time be of the opinion that the Contractor is neglecting to remedy any imperfections in the work, or is not progressing with the work as fast as necessary to insure its completion within the time and as required by the contract, or is otherwise violating any of the provisions of this contract, said Landscape Architect, on behalf of the Owner, shall have the power, and it shall be his duty to notify the Contractor to remedy such imperfections and/or proceed more rapidly with said work, or otherwise comply with the

provisions of this contract.

(B) **Annulment**: In such case the Owner may give the Contractor ten (10) days written notice, and at the end of that time, if the Contractor continues to neglect the work, the Owner may provide labor and materials and deduct the cost from any money due the Contractor under this agreement and may terminate the employment of the Contractor under this agreement and take possession of the premises and of all materials, tools, and appliances thereon, and employ such forces as may be necessary to finish the work. In such case the Contractor shall receive no further payment until the work shall be finished, when, if the unpaid balance that would be due under this Contract exceeds the cost to the Owner of finishing the work, such excess shall be paid to the Contractor; but if such cost exceeds such unpaid balance, the Contractor shall pay the difference to the Owner.

(C) **Owner May Do Part Of Work**: Upon failure of the Contractor to comply with any notice given in accordance with the provisions hereof, the Owner shall have the alternative right, instead of assuming charge of the entire work, to place additional forces, tools, equipment, and materials on parts of the work for the purpose of carrying on such parts of the work and the costs incurred by the Owner in carrying on such parts of the work shall be payable by the Contractor and such work shall be deemed to be carried on by the Owner on account of the Contractor, and the Contractor shall be allowed therefore, the contract price. The Owner may retain the amount of the cost of such work, with seven percent (7%) added for any such sum or sums due or to become due the Contractor under this agreement.

28.00 **PAYMENT TO CONTRACTOR**:

At the end of each thirty (30) days following the agreed upon starting date for the work under this agreement, the Contractor shall estimate the quantities of work completed and have the quantities invoiced verified by the Landscape Architect. The Landscape Architect will certify the amount due the Contractor within 5 working days after receipt. The Owner shall pay the Contractor up to ninety percent (90%) of the amount of the approved invoice within thirty (30) days after receipt.

All partial and final payment requests shall be submitted in duplicate on AIA Documents G 702 and G 703, Application and Certificate for Payment, and shall completely describe and account for all items in accordance with the provisions of the forms. No other forms of payment requests will be accepted.

Upon completion of the work and certification of acceptance by the Owner and its representatives, the ten percent (10%) retained during construction shall be paid to the Contractor. In the event a performance bond is not in force and effect, the retained ten percent (10%) shall be retained by the Owner for the one year guarantee period, after which and if all work is still in acceptable condition the Contractor shall be paid in full.

At the time of issuance of the Certificate of Completion, the Contractor shall be paid the full amount due him within forty-five (45) days. All prior estimates upon which partial payments have been made being merely estimates, shall be subject to adjustment in the final certification. Before final payment is made, the Contractor shall show to the Owner

satisfactory evidence that all just liens, claims and demands of his employees or from parties from whom material used in the construction of the work may have been purchased or procured as duly satisfied, and that the material furnished and the work done are fully released from all such liens, claims and demands.

29.00 **ACCEPTANCE**:

The Landscape Architect shall inspect the work for acceptance within ten (10) days of receipt of written notice from the Contractor that he is ready for such inspection. The listing of items to be completed on a "Certificate of Substantial Completion" or "Punch List" does not constitute a final acceptance of the work and the Contractor shall not submit a final billing on that basis.

30.00 **INSURANCE**:

The Contractor shall comply with the laws of the State of which the work is performed regarding employment and payment of employees, and shall maintain insurance satisfactory to the Owner to protect both himself and the Owner from claims under workmen's compensation acts and from any other damages for personal injury, including deaths, which may arise from operations under this Contract, whether such operations by himself or by any subcontractor or anyone directly or indirectly employed by either of them. Certificates of such insurance shall be filed with the Landscape Architect and shall be subject to his approval for adequacy of protection.

The Contractor shall furnish the Owner Certificates of Insurance evidencing such protection.The Contractor shall provide and maintain Workmen's Compensation Insurance for all of his employees employed at the site of the work; General Liability and Contingent or Protective Insurance as shall protect himself and the Owner from any and all claims that may arise from damage for personal injury, including accidental death as well as for claims for property damage which may arise from operations under this Contract. For the purpose of this agreement, the contractor shall carry the following types of insurance in at least the limits specified as follows:

Coverages	Limits of Liability
Builders Risk	Same Amount as Total Contract
General Liability	
Commercial General Liability	$1,000,000.00 Gen. Aggregate $500,000.00 Each Occurrence
Automobile Liability	
Combined Single Limit	$500,000.00
Excess Liability	
Umbrella Form	$1,000,000.00 Each Occurrence $1,000,000.00 Aggregate

Workman's Compensation	Statutory Limits $100,000.00 Each Accident

All policies affording the various coverages required by this section shall be endorsed to provide for a thirty (30) day prior written notice to be delivered to the Certificate Holder before any of the coverages afforded by these policies are either reduced or canceled.

The General Liability Policy shall name MCSA Group, Inc. and Owner as indicated on the Agreement Form as additional insured for the length of the agreement.

The name of the project should be listed on the Certificate of Insurance.

The Contractor is advised that the Owner is not liable for the safety, security, or condition of his equipment or materials.

31.00 **TIME AND RESPONSIBILITIES**:

The work under this agreement shall be inspected by the firm of MCSA Group, Inc., Landscape Architects and Architects, 529 Greenwood Avenue S.E., East Grand Rapids, Michigan 49506, herein called the Landscape Architects. The Contractor shall be responsible to said firm as agents of the Owner, as well as the Owner for proper execution of said agreement. The Contractor shall notify the Landscape Architect, in writing, of concerns about their ability to conform to work progress schedules outlined at the pre-construction of any other work-related items in ample time to avoid unnecessary delays or alterations to the Contract.

32.00 **DAMAGES FOR NONCOMPLETION**:

The Owner shall withhold the aforestated amount of not less than $500.00 per day for each day of suitable working weather, except for Sundays and legal holidays, that the Contractor exceeded the specified date for completion of the work as compensation for liquidated damages and additional costs suffered by the Owner due to the Contractors failure to complete the work as specified.

In the event the Landscape Architect is required to provide construction administration for inspection services after the specified completion date, the cost of this work shall be paid by the Contractor. The cost of these services shall be $100.00 per hour, including: all travel time; all on-site time; and all office administration time. These costs shall be deducted from outstanding retainage and paid by the Owner to the Landscape Architect. Additionally, the Contractor shall pay for travel expense to and from the site at $.50 per mile. The cost of these services shall be deducted from the contract retainage and paid by the Owner to the Landscape Architect.

33.00 **GUARANTEE**:

The Contractor shall guarantee all materials, equipment, and workmanship against defects for a period of one (1) year from the date of final acceptance. Any failure of materials during this period shall be removed and completely replaced and guaranteed for one year at no additional cost to the Owner.

34.00 **MAINTENANCE**:

The Contractor shall provide maintenance, as specified, on all landscape materials during and after construction through the one (1) year guarantee period, which begins on the date of certification of final acceptance or as herein specified.

35.00 **CONTRACTORS IDENTIFICATION SIGN**:

The Contractor shall furnish and install a contractors identification sign which lists all construction contractors and design and engineering firms by name and type of work. Sign layout shall be approved by the Landscape Architect prior to painting. Location on the site shall be as directed by the Landscape Architect. The Contractor shall furnish this sign as part of the contract with no additional cost to the project.

36.00 **SHOP DRAWINGS**:

The Contractor shall submit electronic copies of all shop drawings for any manufactured or fabricated item of work for review and approval prior to commencement of that work. Subcontractor shop drawings shall be submitted through the prime Contractor and shall be checked and approved by the Contractor prior to submission to the Landscape Architect.

Shop drawings shall clearly and accurately illustrate every aspect of the item of work and include dimensions, types of materials, fasteners, finishes, space requirements, performance and quality ratings and approvals and all other relevant information.

Shop drawings shall be required for all work items that are not totally described in the plans and specifications or for items that require unusual or specialized fabrication, whether or not it is so stated.

Submit shop drawings via email. Approved shop drawings shall be signed by the Contractor and the Landscape Architect. The Landscape Architect will electronically return to the Contractor for subcontractor distribution in a timely manner.

37.00 **PRODUCT DATA AND SAMPLES**:

Product data and samples shall be submitted for all items specified or requiring further clarification, for purposes of modifying or substituting a specified material or to determine acceptability of a given product. Submissions should include the name of the source, specific product characteristics and capabilities, product cost and all other relevant information in sufficient size and description to make a realistic evaluation of the material.

38.00 **MANUFACTURER'S SPECIFICATIONS AND RECOMMENDATIONS:**

All product materials, equipment and site furnishings of any kind shall be installed as specified and recommended by the manufacturer. The Contractor shall obtain from each manufacturer their comprehensive specifications and recommendations for utilization of their product. All assembly, installation and utilization shall be in conformance with the

manufacturer's specifications and recommendations. In the event that any portion of these specifications and related plans and details vary from the manufacturer's specifications and recommendations, it shall be the Contractors' responsibility to immediately notify the Landscape Architect prior to any construction for clarification and directions on product utilization and installation.

39.00 **RECORD DOCUMENTS**: (AS-BUILTS)

Record documents are defined to include those documents or copies relating directly to performance of the work, which Contractor is required to prepare or maintain for Owner's records, recording work as actually performed. In particular, record copies show changes in work in relation to work in which shown or specified by original contract documents; and show additional information of value of Owner's records, which was not indicated in original contract documents. Record copies include marked-up product data submittals, record samples, field reports for variable miscellaneous record information on work which is otherwise recorded only schematically or not at all.

a. At the time of substantial completion, submit record drawings to Architect for Owner's records. Organize into sets, bind and label sets for Owner's continued use.

40.00 **OPERATING AND MAINTENANCE DATA**: (MANUALS)

"Operating and Maintenance Manuals" are to be prepared for the Owner and the Owner's personnel. These manuals contain information necessary for the safe and efficient operation and maintenance of equipment and operating systems, and information relative to the inspection, care and maintenance or repair of products and finishes.

Each manual shall include the following:

General system or equipment description.
Copies of applicable shop drawings and product data.
System equipment identification, including name of manufacturer, model number and serial number of each component.
Operating instructions.
Emergency instructions.
Wiring diagrams.
Inspection and test procedures.
Maintenance instructions and procedures.
Precautions against improper use and maintenance.
Copies of Warranties.
Repair instructions including spare parts listing.
Names and addresses of sources of required maintenance materials and related services.

TECHNICAL SPECIFICATIONS

SITE

TECHNICAL SPECIFICATIONS
GENERAL SITE CONDITIONS - SECTION 02050

PART I - GENERAL

1.01 Maintenance of Survey Information

The Contractor shall be responsible for maintaining all layout information, elevations, bench marks, and general site information provided or approved by the Owner and/or Landscape Architect. Survey or layout information lost or displaced or in any way disturbed through neglect or any construction activity by the Contractor or any of his employees or representatives shall be restored by the Contractor at his expense.

1.02 Layout and Staking

The General Contractor shall be responsible for layout staking, grade staking and for getting approvals for all work for himself and/or his sub-contractor. The Contractor shall employ a Registered Land Surveyor who shall establish and maintain all lines and levels required for laying out and constructing the work. The Contractor agrees to assume all responsibility due to inaccuracy of any work of said Surveyor, and including incorrect benchmarks, their loss or disturbance.

The Contractor shall provide on-site assistance for any work specified to be laid out by the Landscape Architect. The Contractor shall also be responsible for any additional staking required for field adjustments by the Landscape Architect.

1.03 Soil Testing

The General Contractor shall be responsible for all soil testing throughout the course of the project on a daily basis or as required. Testing shall be done to ensure the stability of all graded areas and proposed items of work. All testing shall be conducted by a professional soil testing specialist. Results of all testing shall be delivered to the Landscape Architect weekly, upon completion.

1.04 Sub-Contractor Layout Verification

Each sub-contractor shall verify layout stakes, grades and other information as it pertains to his particular work and report any errors or inconsistencies to the Landscape Architect before commencing work. Starting the work shall imply his acceptance and willingness to correct any errors at his expense.

1.05 Protection of Existing Features

The Contractor shall save and protect, to the highest degree possible, all areas and features of the site that are not identified as construction items. Unnecessary disturbances or damage shall be considered the responsibility of the Contractor for complete restoration at no additional expense to the Owner.

1.06 Water, Power, and Sanitary Sewer

The Contractor shall provide all water, electrical, mechanical and toilet services and facilities as may be required to properly execute the Contract and provide proper maintenance throughout the guarantee period.

1.07 **Miss Dig**

The Contractor shall be responsible for notification to MISS DIG, one number utility alert (1-800-482-7171), for location of public utility service lines where digging or deep excavation operations could disturb or sever such lines. The Contractor shall pay for all repairs, restoration and damages resulting from failure to properly fulfill such notification and location requirements.

TECHNICAL SPECIFICATIONS
REMOVAL ITEMS - SECTION 02100

PART I - GENERAL

1.01 Description

This work shall consist of the complete removal of all items called for in the plans and specifications or as otherwise implied in a safe and orderly manner creating as little disturbance as possible.

Unless otherwise specified all areas indicated for construction of any kind shall be cleared of any debris, undergrowth, weeds, stumps, roots, and marked trees which might interfere with the progress of that work. Unmarked trees or any plant materials indicated to be saved by the Landscape Architect shall be given special protection as specified.

PART II - PRODUCTS (Not Applicable)

PART III - EXECUTION

3.01 Protection of Items to Remain

Extreme care shall be utilized when removing any item adjacent to structures, utilities, paving, vegetation or any item not indicated for removal or relocation. These items shall be properly protected as required to keep them from damage or other disturbance of any kind during the course of the work.

Special consideration should be taken at tree removal located on the property South of Second Avenue. Per plans, remove tree above grade, grind down stump 10" below the existing grade taking care not to disturb the trees root system.

Care should be taken to work from open areas when working around plants that are to be saved to avoid unnecessary soil compaction and other damages that might occur. Only hand methods shall be utilized for removal of roots and debris under the drip line of trees that are to remain.

3.02 Plant Damage Compensation

Damage inflicted to any trees or plant materials by the Contractor shall be compensated for at a rate established by the American Society of Consulting Arborists, Inc.

3.03 **Removal Responsibility**

All debris, trees, stumps, or soil to be cleared and removed from the project area shall be disposed of off the site at an approved disposal area at the arrangement and expense of the Contractor.

No materials will be stockpiled on site for future disposal nor will any excavation areas be left in unsafe or unsightly conditions at days end. The Contractor will be responsible for all transportation and disposal fees associated with this work. Burning of cleared, grubbed, or construction waste materials is not permitted on the Owner's property.

3.04 **Utility Shut-Off**

The Contractor shall ascertain the location of all existing utilities and accept total responsibility for shut-off and avoidance of all such utilities during construction. All utilities to be disconnected, plugged, and capped, or otherwise taken out of service shall be the responsibility of the Contractor and shall be properly executed with skilled tradesmen in accordance with the standards and practices of the trade.

TECHNICAL SPECIFICATIONS
EARTHWORK AND GRADING – SECTION 02200

PART 1 - GENERAL

1.01 Description

The work consists of all work as called for by the plans and/or proposal form and may include: rough and finish grading to approved grade stakes; excavation of organic or unstable soils; excavation, stockpiling and redistribution of topsoil; placement of subbase for construction items not covered by sub-contractors; placing and grading supplemental topsoil; and all other grading and excavation operations, unless otherwise called for in the plans and specifications, all in conformance to Act 347, Soil Erosion and Sedimentation Control, as locally administered and enforced.

1.02 Submittals

Provide product data or test and Evaluation reports for each type of product indicated.

A. Sub base materials indicated on drawings.
B. Topsoil.

PART II - PRODUCTS

2.01 Fill Materials

Fill and backfill materials shall be MDOT Class II or approved clean, porous granular materials free of clay, rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, vegetation or other deleterious matter.

2.02 Subbase Materials

Subbase materials shall be the specified properly graded mixture of natural or crushed gravel, crushed stone, crushed slag or natural processed sand that will readily compact to the required density and remain in that state under normal conditions.

2.03 Topsoil

Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth. It shall be reasonably free from subsoil and stumps, roots, brush, stones (1 inch or more in any dimension), clay lumps or similar objects. Existing vegetation including brush and noxious weeds shall be removed from the soil surface and disposed of prior to stripping of the topsoil. Ordinary sod can be thoroughly broken up and intermixed with the soil during handling operations. Topsoil shall be classifiable as a loam, silt loam, silty clay loam, or clay loam, as determined from the Bureau of Plant Industrial, Soils and Agricultural Engineering, USDA triangular soil texture chart.

The topsoil, unless otherwise specified or approved, shall have a ph range of approximately 5.5 to 7.5, when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall not be less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction) test.

2.04 **Screened Imported Topsoil**

Prior to obtaining additional material to be used for imported topsoil, the Landscape Architect shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements of well drained soil specified and to determine the depth to which stripping will be permitted. At this time, the Contractor shall be required to take representative soil samples from several locations within the area under consideration to the proposed stripping depths for testing purposes as specified above, and shall have them professionally tested by a laboratory approved by the Landscape Architect prior to approval of the soil. Topsoil must be screened to remove all debris.

PART III - EXECUTION

3.01 **Stripping Topsoil**

Topsoil in areas that are to be graded shall be stripped to the depth designated and stockpiled in an area approved by the Landscape Architect outside of the construction work areas. Stockpiles shall be graded and shaped to ensure proper drainage and minimize wind erosion.

3.02 **Removal of Unsatisfactory Materials**

All organic, unstable or otherwise unsatisfactory soils shall be excavated to stable soil and replaced with an approved sand or gravel compacted as specified.

3.03 **Excavation for Structures**

Grading for structures shall be to the tolerances specified and shall extend sufficient distances from footings and foundations to permit placing and removal of formwork, installation of services, other construction operations and inspection.

3.04 **Placing Fill**

During grading and filling operations, all fill shall be placed in ten inch (10"), or less, layers and compacted by operating heavy track or rubber tired equipment over it.

3.05 **Compaction of Soil**

Soil compaction for all graded or fill materials shall be at least 95% ASTM D 1557 or

Proctor Density and shall be achieved under optimum moisture conditions unless otherwise specified.

3.06 **Grade Tolerance**

All earthwork grading shall be within one inch (1" or 0.083') of the elevations called for on the plans. All pavement and surface grading; and curb and gutter elevations shall be within one quarter inch (1/8" or 0.0104') of the elevations called for in the plans. All grading shall drain uniformly to designated low points and all changes in elevation and transition areas shall be with gentle, rounded gradients.

No horizontal walk grades will exceed 5% (1 in 20) with the exception of curb ramps which may be up to 8.33% (1 in 12) for a distance of not over 6 feet. No walk cross slopes shall exceed 2% (1 in 50). No barrier free parking spaces and/or loading aprons shall exceed 2% (1 in 50) in any direction.

The Landscape Architect may check finished grades with a smart level to ensure compliance with the plans, Americans with Disabilities Act (ADA) and the requirements stated above. All paving not meeting these requirements shall be removed and replaced by the Contractor at no cost to the Owner.

3.07 **Maintenance of Graded Areas**

Recently completed sub and finished grade work areas shall be protected from erosion, traffic and accumulation of debris. The Contractor shall scarify, regrade and otherwise restore settled, eroded, and/or rutted areas to the specified grades and approval of the Landscape Architect.

TECHNICAL SPECIFICATIONS
BITUMINOUS CONCRETE PAVING - SECTION 02513

PART I - GENERAL

1.01 Description

This work shall consist of the placing of bituminous concrete as called for in the plans and details.

1.02 Weather Limitations

Apply bituminous prime and tack coats only when the ambient temperature in the shade is above 50° F. and when the temperature has not been below 35° F. for 12 hours immediately prior to application. Also, do not apply when the base surface is wet or contains an excess of moisture, which would prevent uniform distribution and the required penetration.

Construct asphalt concrete and patching surface course only when atmospheric temperature is above 40° F., when the underlying base is dry, and when weather is not rainy. Base course may be placed when air temperature is not below 30° F. and rising, when acceptable to the Landscape Architect.

1.03 Grade Control

Establish and maintain the required lines and grades, including crown and cross-slope for each course during construction operations.

Accessible parking spaces shall not have a slope greater than 2% (1'v:50'h) in any direction.

1.04 Submittals

Provide product data for each type of product indicated.

A. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the work.

PART II - PRODUCTS

2.01 **Materials**

A. Bituminous Mixtures shall conform to the requirements of the current Michigan Department of Transportation's Standard Specifications for Construction and as noted herein. The base course will generally be Bituminous Base Mixture No. 13A; the leveling course, Bituminous Mixture No. 13A, and the top (wearing) course, Bituminous Mixture No. 5E1 otherwise specified in the proposal or on the plans..

The bituminous material for base mixtures shall have a PG Binder Grade of PG64-22 and the bituminous material for surface mixtures (wedging, leveling, and top course) shall have a PG Binder Grade of PG64-22 for 13A and 36A.

Bituminous Mixtures shall be prepared in a bituminous mixing plant which has been pre-qualified by the Michigan Department of Transportation or as approved by the Landscape Architect and shall be in accordance with the current Michigan Department of Transportation's Standard Specifications for Construction.

B. Prime Coat and Tack Coat, when specified, shall conform to the current requirements of the Michigan Department of Transportation's Standard Specifications for Construction. Prime coat will be MS-OP and tack coat will be SS-1h unless otherwise specified.

C. Herbicide, Triox or equal shall be used for treatment of all subgrade areas prior to placement of aggregate base.

D. Seal Coat or Slurry Seal, when specified, shall conform to the current requirements of the Michigan Department of Transportation's Standard Specifications for Construction Section 506.

PART III - EXECUTION

3.01 **Construction Methods**

Construction methods to be used for placing bituminous mixtures shall conform to the requirements of the current Michigan Department of Transportation's Standard Specifications for Construction, except as noted herein.

All existing paved surfaces to be newly paved shall be thoroughly cleaned of loose and foreign materials and dry and shall be tack coated prior to placement at a minimum rate of .02 gal/sy. Prime coat cut surfaces to receive asphalt patch and between asphalt. All paving operations shall cease when the surface to repave is wet.

Joint and crack cleanout covers the work of removing existing joint sealant and foreign materials, to a depth of up to 1"from transverse and longitudinal joints and cracks prior to resurfacing. The work is usually done with a hooked device, not unlike a stove poker. The pay item is "Joint and Crack, Cleanout", measured in feet of joints and cracks so treated. Cleaned cracks 1” wide and greater shall be filled with hand patching.

All mixing, spreading, finishing, compacting, constructing joints and joint and crack cleanout shall meet Michigan Department of Transportation's Standard Specifications for Construction

3.02 Equipment

Equipment to be used for placing bituminous pavements shall conform to the requirements of the current Michigan Department of Transportation's Standard Specifications for Construction.

3.03 Line Striping

Following completion of all bituminous paving, stripe all areas as per the plans and details.

All line striping must be laid out per the plans and specifications with marked with chalk lines for approval by Landscape Architect PRIOR to any striping work.

Utilize an acrylic latex emulsion paint, white in color, to provide a 4” wide dense line complete covering the pavement, use blue color for barrier free spaces. Use approved blue color for barrier free stripping and symbols.

When called for on the plans, cold plastic overlay shall be used in lieu of paint. Cold plastic material and installation methods shall conform to MDOT Section 811.

Seal coated paving should be allowed to dry for a 24-hour period before striping.

TECHNICAL SPECIFICATIONS
CONCRETE WORK - SECTION 02514

PART I - GENERAL

1.01 Description

This work shall consist of all labor, equipment, and materials necessary for complete installation of site concrete work as called for in the plans and details.

1.02 Testing

Standard 6-inch cylinders for compression tests of the concrete shall be prepared from each pour. Concrete for test specimens and assistance for making them on the project will be furnished by the Contractor. The furnishing of molds, the actual making of the test cylinders and all testing will be performed by the Contractor.

The sample shall be tested in accordance with the specification of the American Society for Testing Materials, Serial Designation C-31 or the current Michigan Department of Transportation Specifications. If the average results from test specimens cured at an average temperature of 70° F are below the 28 day required compressive strength it will be sufficient reason for rejecting for further use the materials entering into the concrete.

1.03 Quality Assurance

Provide 3’ x 3’ mock-up of exposed aggregate paving.

PART II - PRODUCTS

2.01 Concrete

Concrete shall be Type A, air-entrained concrete with a slump of not less than 3 inches nor more than 4 inches unless otherwise specified.

Portland Cement shall conform to the requirements of the current ASTM Specifications for Air-Entraining Portland Cement.

Fine Aggregate shall conform to the requirements for "Natural Sand, 2NS" of the current Standard Specifications of the Michigan Department of Transportation.

Course Aggregate shall conform to the requirements for Course Aggregate, 6 A (limestone) of the current Standard Specifications of the Michigan Department of Transportation.

Course aggregate for exposed aggregate and sandblasted concrete to be natural, dense graded 3/8 inch round stone with a maximum of five percent (5%) fines with the stone. Only washed and graded stone will be accepted. Crushed stone will not be accepted. Aggregate with soft, porous, calicious or other low quality stone will be rejected. Color of aggregate to be natural stone with a predominance of bluff or brown stone.

At location on Project selected by Landscape Architect, place and finish 2 each, 3'x3'. Demonstrate methods of obtaining consistent visual appearance, including materials, workmanship, and curing method to be used throughout Project.
Retain samples of cements, sands and aggregates used in mock-up for comparison with materials used in remaining Work.

Textural indicators shall be as per plans and detail. Provide full size sample for approval of Landscape Architect.

Water for mixing and curing the concrete shall be from Municipal Potable Water Supply, unless otherwise specified.

2.02 **Reinforcing**

Steel Reinforcement Materials shall conform to the requirements of current Standard Specifications of the Michigan Department of Transportation.

2.03 **Additives**

Curing of the concrete shall be performed by one of the appropriate methods as specified for "Concrete Curing Agents" in the current Standard Specifications of the Michigan Department of Transportation. Only clear curing agents or other methods that will not affect the natural colorations of the concrete will be permitted. Care shall be taken to avoid using agents or methods that affect the future use of specified sealants.

Calcium chloride shall not be used in any concrete without written approval from the Landscape Architect.

Ready mix concrete shall conform to the requirements of ASTM C 94. Batch plants must meet the requirements of ACI 304. Hand mixing will not be permitted except in emergencies or for very small quantities.

Air entraining admixtures shall conform to ASTM C 260 and shall be constituted so that the total air content is not less than 5% nor more than 8%.

2.04 **Synthetic Fiber Reinforcing**

Synthetic fiber reinforcing shall be 100% virgin homo polymer polypropylene fibrillated fibers as manufactured by the Fibermesh Company, 125 Meridan,

Dearborn, Michigan, (313) 278-7205, by Forta Corporation, 100 Forta Drive, Grove City, Pennsylvania 16127 (1-800-245-0306), or approved equal.

Synthetic fibers shall be incorporated into all concrete whether indicated on the drawings or not. The incorporation of said fibers shall be documented on the delivery ticket from the ready mix producer.

Fibers shall be added to the concrete in strict accordance with manufacturer's printed instructions. Synthetic fibers shall be 3/4" in length and shall be added at a rate of 1-1/2 lbs./cubic yard of concrete.

PART III - EXECUTION

3.01 Concrete Mixing

The proportioning of aggregates and cement shall be weight in accordance with the current Michigan Department of Transportation "Mortar Voids" theory with the quantities of each shown on the delivery tickets for each batch.

Concrete shall be mixed only as required for immediate use and any which has developed initial set shall not be used. Concrete which has partially hardened, shall not be retempered or remixed. The use of a fractional sack of cement will not be permitted unless the fractional part is measured by weight. The mixer shall be cleaned thoroughly each time when out of operation for more than 30 minutes.

Concrete mixes will be measured as described in the current "Method of Slump Test for Consistency of Portland Cement Concrete" of the ASTM Designation C-143. The concrete shall at all times be of such consistency and workability, that it can be puddled readily into corners and angles of the forms and around joints, dowels, tie bars and reinforcement without excessive spading, segregation or undue accumulation of water or laitance on the surface.

The mixing of concrete in truck mixers enroute from the batching plant to the site of the work will be permitted only for mixers equipped with an approved revolution counter which will either record the number of revolutions of the mixer drum at mixing speeds and the number of revolutions at agitating speeds, for each batch, or will record the revolutions of the mixer drum only when the mixer is operating at mixing speeds. Truck mixers not so equipped shall mix the concrete at the batching plant site. The mixing shall be done on a reasonable level area, sloping not more than 2 percent in any direction.

The concrete shall be discharged within a period of one hour after the introduction of the mixing water with the dry materials or within a period of 1-1½ hours after the cement has been placed in contact with the aggregates, and it shall be within the specified limits for consistency and air content and it shall not be segregated.

3.02 **Forming**

Concrete which is improperly formed, is out of alignment or level or displays surface defects shall be removed and replaced by the Contractor at no additional cost to the Owner unless patching or other corrective measures are approved. Approved permission to patch or otherwise correct such defects does not waive the Owners Agent's right to require complete removal of the defective work if the corrective measures do not adequately restore the quality and appearance of the concrete.

Forms shall be metal or wood, straight and free from distortion, and of sufficient strength to resist springing during the process of depositing and finishing the concrete. Wood forms or flexible steel forms shall be used on circular curb or special sections and shall be defined as any curved section of curb or wall constructed on a radius of 150 feet or less. They shall be of an approved section with a flat surface on top. The forms shall be of the full depth of the structure and shall be well built, substantial and unyielding. They shall be securely staked, braced, and tied to the required line and grade and sufficiently tight to prevent leakage of mortar. The inside surface of the forms shall be oiled with a light, clear paraffin-base oil which will not discolor or otherwise injuriously affect the concrete as on the walls to be treated with Thoroseal or equal.

Placing concrete shall not be permitted until the subgrade and forms have been approved by the Landscape Architect. The subgrade shall be wetted and the concrete deposited to the proper depth. The concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which it shall be floated smooth and even by means of a wooden float.

3.03 **Reinforcement**

All steel reinforcement shall be accurately placed in the position shown on the approved plans and firmly held during the placing of concrete. When placed in the work, it shall be free from dirt, rust, mill scale, paint, oil or other foreign material. Bars shall be placed with a variation in spacing between adjacent bars of not more than one-sixth of the spacing shown on the plans, and the clear distance from the near surface of the concrete to the reinforcement shall not vary from the distance shown on the plans by more than one-fourth the plan distance. Bars shall be tied at all intersections except where the spacing is less than one foot in each direction in which case alternative intersections shall be tied. Supports for reinforcement which are to remain in the work shall be either precast concrete blocks of approved shape and dimensions, or approved preformed steel bar-chairs.

Bars shall not be spliced except as provided on the plans or as authorized by the Landscape Architect.

3.04 **Finishing**

Edges on all concrete shall be rounded to a radius of 1/4 inch with an approved finishing tool unless otherwise specified. All joints shall be rounded with an approved double edging tool having a radius of 1/4 inch on each side and the surface shall then be brushed lightly to produce a slightly roughened surface and remove the finishing tool marks except where otherwise specified.

All Portland Cement Concrete shall be finished with a light broom finish in the direction indicated on the plans, unless otherwise specified.

Location of control joints are subject to Landscape Architects approval.

Exposing Aggregate: Begin exposing aggregate when paving will bear weight of cement mason on knee boards without indention. Brush with bristle broom and fine water spray to remove excess mortar until exposure of aggregate is uniform and at proper depth as approved by the Landscape Architect.

3.05 **Protection**

Protection of Concrete shall be performed in the following manner:

Sealant for curing shall be applied immediately in accordance with manufacturer's recommendations. (See part 3.05a)

Protection Against Rain - The Contractor shall take such precautions as are necessary to protect the concrete from damage.

Hot Weather Limitations - Casting of concrete during hot weather shall be limited by the temperature of the concrete at the time of placing. Concrete shall not be cast when the temperature of the concrete is above 90° F. Care shall be taken to properly wet and protect all concrete placed in direct sun or in hot weather.

Cold Weather Limitations - No concrete shall be placed unless the temperature of the air in the shade and away from artificial heat is at least 25° F. and rising unless specifically approved.

Protection from Cold Weather - The Contractor shall be responsible for the concrete placed during cold weather and any concrete injured by frost action shall be removed and replaced at his expense.

3.05a **Sealant**

Sealant for curing shall be Kure-N-Seal 25 LV by Sonneborn. Sealant shall be applied at a coverage rate of 250 square feet per gallon. For application, proper surface preparation and drying time, consult the coatings manufacturer for more instructions. Sealant must comply with ASTM C 1315-96 Type I, Class A. Kure-N-Seal 25 LV by Sonneborn is available from S. A. Morman & Co. ph. 1.800.968.8012.

Sealant for curing of exposed aggregate and sandblasted concrete shall be Kure-N-Seal 30 by Sonneborn. Sealant shall be applied at a coverage rate of 250 square feet per gallon. For application, proper surface preparation and drying time, consult the coatings manufacturer for more instructions. Sealant must comply with ASTM C1315-96, Type 1, Class A. Kure-N-Seal 30 by Sonneborn isavailable from S. A. Morman & Co. ph. 1.800.968.8012.

For subsequent coating applications, use Sonosil Curing aid, hardening and dustproofing compound for concrete. For application, proper surface preparation and drying time, consult the coatings manufacturer for more instructions. Sonosil by Sonneborn is available from S. A. Morman & Co. ph. 1.800.968.8012.

3.06 **Curing**

Forms shall be left in place for a period of not less than 12 hours. Immediately after they have been removed, all porous or honeycomb areas thus uncovered shall be filled smooth with mortar consisting of one part cement and two parts fine aggregate. Also, the ends of all expansion joints shall be cut open to the full width of the expansion joint material.

The main supporting forms, including all shoring and bracing shall remain in place for a period of not less than seven (7) days, and for such longer period as the Landscape Architect may direct.

3.07 **Expansion Joints**

Contractor to indicate the layout of the proposed expansion joints required in all concrete areas if not shown on construction documents.

Expansion joints at to be placed at a minimum of 30’ intervals to correct elevation and profile.

Contractor to align curb, gutter; and sidewalk expansion joints.

Place joints between paving components and building or other appurtenances.

Location of expansion joints is subject to approval of the Landscape Architect.

TECHNICAL SPECIFICATIONS
JOINT FILLER AND SEALANT - SECTION 02515

PART I - GENERAL

1.01 **Description**

This work shall consist of the complete installation of specified expansion joint filler and joint sealant as called for in the plans and details.

1.02 **Submittals**

Sealant manufacturer's instructions, including limitations for application and priming. Indicate on the brochure or by transmittal which primers will be used or submit printed statement from sealant manufacturer that no primers are required for maximum adhesion.

Sealant manufacturer's standard color range for color selection. Color will be selected by the Landscape Architect.

PART II - PRODUCTS

2.01 Expansion joint material shall be pre-molded, non-staining and compatible with sealant and primer, and of a resilient nature such as closed cell resilient foam or sponge rubber. Sonoflex - F closed cell foam as manufactured by Sonneborn Building Products and available from Ersco Corporation, 2643 - 28th Street, Wyoming, Michigan, A/C 616-531-7050, or approved equal shall be used. Materials impregnated with oil, bitumen, or similar materials shall not be used. Provide back-up materials only as recommended by sealant manufacturer in writing. Joint material shall be 33% to 50% larger than joint width.

2.02 Expansion joint cap shall be white cap or snap-cap premolded P.V.C. expansion joint cap.

2.03 Joint sealant shall be Sonolastic SL 1 self-leveling polyurethane sealant as manufactured by Sonneborn Building Products and available from Ersco Corporation, Wyoming, Michigan.

PART III - EXECUTION

3.01 **Joint Preparation**

All joints surfaces shall be dry and thoroughly clean. Remove all loose particles, dirt, paint, foreign matter, or curing compound by means not injurious to the material to be sealed and that will not change the appearance of the exposed surfaces adjacent to the

sealant joint.

3.02 **Sealant Application**

All joints shall be neatly finished to assure proper filling of voids, elimination of air pockets and maximum contact at joint interfaces.

After surfaces of joints are cleaned, joint interfaces shall be primed and then joint sealant installed over expansion joint material. Sealant shall be brought close to the surface without overflowing and form a slightly concave joint seal.

Where required because of excessive slope, a non-sag variety of the same joint sealant shall be installed with a caulking gun and the joints tooled. Where required to avoid smearing exposed surfaces of joint use masking tape and remove after installation.

No sealant shall be applied to a joint at temperatures other than those per manufacturer's recommendations.

Wherever possible, sealant application shall be scheduled for seasonal periods (medium temperature) when joints are at their normal size.

Sealant SHALL NOT be applied over incompatible materials, oil base or asphaltic products, any migratory saturant or any other materials or sealant in which the bonding properties and adverse effects resulting from the combination are not known.

Modification of a sealant by the addition of liquids or powders to alter its flow properties SHALL NOT be permitted.

A sealant SHALL NOT be used if the date of manufacture indicates that the sealant is more than 12 months old. Where a lesser period is recommended by the manufacturer, the lesser period shall govern.

3.03 **Quality**

Any sealed joint not completely filled or properly finished shall be reopened and replaced as directed and sealed as specified. No rough or unsightly work shall be accepted.

TECHNICAL SPECIFICATIONS
UTILITY AND STORM SEWER WORK - SECTION 02721

PART I - GENERAL

1.01 Description

This work consists of all labor, equipment, and materials necessary for complete construction of new sewer lines and structures; adjustment of existing structures and abandonment of existing sewers and structures as called for in the plans.

1.02 General

The Contractor shall verify the location of all existing utilities through the MISS DIG Utility Communication System, 800-482-7171 or 811 prior to commencement of any excavations. If utilities are to remain in place, provide adequate means of protection during earthwork operations.

Construction of any kind shall in no way affect the performance of existing systems. The Contractor shall be completely responsible for the proper and timely execution of the work and shall repair and/or restore, at no cost to the Owner, any damages occurring during or as a result of his actions.

All costs incurred in the installation of sheeting or bracing shall be incidental to the price bid for the furnishing and laying of the pipe, and no extra compensation will be allowed. Note: All Shoring and bracing shall comply with the State of Michigan Construction Safety Code.

Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Landscape Architect immediately for directions as to procedure. Cooperate with the Owner, and public and private utility companies in keeping the respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.

Demolish and completely remove from the site underground utilities indicated to be removed. Coordinate with local utility companies for shut-off of services if lines are active. Underground utilities which are indicated to remain permanently are to be closed with sufficiently strong closures to withstand pressures which may result after closing.

Unsatisfactory soil materials encountered that extend below the required elevations shall be excavated, to the additional depth directed by the Landscape Architect and removed from the site.

Such additional excavation, provided it is not due to the fault or neglect of the Contractor, will be measured as directed by the Landscape Architect and paid for as a change in the work.

PART II - PRODUCTS

2.01 **Storm Sewer Pipe**

Storm sewer pipe shall be one of the following unless otherwise specified.

a. High density corrugated polyethelene smooth interior wall pipe - ADS N-12 or Hancor Hi-Q.

b. Extra strength plain joint concrete pipe, Michigan Designation C 14 - X M5.

2.02 Catch Basins and Manholes shall have an inside diameter of 4', except as otherwise noted. They shall be made of precast concrete pipe conforming to ASTM C-478 or of 6" thick concrete manhole blocks with an exterior plaster coat of 1/2" thick mortar. The tops shall be tapered to receive the frame and cover specified. The bases shall be 6" thick concrete minimum.

2.03 Catch Basin Castings shall be East Jordan Iron Works as specified in the drawings, or approved equal.

PART III - EXECUTION

3.01 **Construction Methods**

Excavation of the trench shall begin at the outlet end and proceed toward the upper end true to line and grade. The maximum width of the trench shall be 36" for 8" pipe but of sufficient space for bracing and supporting sides of trenches and for pumping and draining of ground water and sewage.

Fire Hydrants and other utilities shall be kept operative and accessible for immediate use at all times.

Where existing underground conduits and structures are encountered, the Contractor shall provide and install adequate supports and protection for all sewer and water pipes, and other utilities extending into or crossing the trench. Where gas mains or electric cable or conduits into or cross the trench, the Contractor shall notify the Owner at once and provide such supports and protection as may be required by the Owner.

Where mains, cables or conduits are parallel to the contractor's trench opening, the Contractor shall so carry on his work at all times as not to cause damage to the paralleling structure or structures.

Where gas, water or sewage service connections to occupied buildings must be temporarily disconnected, the Contractor shall give at least one (1) weekday notice to the Owner of the time and duration of the anticipated cut-off.

When pipes, conduits or sewers are removed from the trench leaving "dead" ends in the ground, such ends shall be fully plugged or bulkhead with brick and mortar by the Contractor without additional compensation.

Removal or replacement of existing drainage structures, if required, shall be incidental to furnishing and laying of pipe, and no extra compensation will be allowed.

Temporary conduits shall be installed by the Contractor without additional compensation, to divert and control water and sewage that may flow along or across the site of the work.

The Contractor shall remove by pumping, bailing or otherwise, any water, which may accumulate or be intercepted or be found in the trenches and in any other excavation made under this contract. He shall form all dams, flumes or other work necessary to keep the trenches entirely clear of water and sewage while the structures and their appurtenances are being constructed. The Contractor shall at all times have sufficient pumping equipment on the job ready for immediate use.

Water from the trenches and excavations shall be disposed of in such a manner as will not cause injury to the public health, not to public or private property, not to the surface of the streets, nor cause any interference with the use of the streets by the public. No additional payment will be made to the Contractor for this work.

Backfill materials shall be placed on sections of the sewer only after such sections have been approved by the Landscape Architect, and/or testing laboratory for backfilling. Michigan Department of Transportation Class II Material shall be placed under and around the barrel of the sewer until the sewer is completely covered to a depth of at least one (1) foot. This portion of the backfill shall be placed in layers not more than (6) six inches in thickness, and each layer thoroughly compacted, without damaging or displacing the sewer. The balance of the backfill, including that around manholes, catch basins, and other structures, shall be Michigan Department of Transportation Class II and shall be placed in layers not more than 12" thick, each layer being fully compacted, using vibrators or other mechanical means as approved by the Landscape Architect. Flooding of trenches as a method of compaction will not be permitted, however, addition of water may be required to reach a desired moisture content of backfill materials. All utility backfill shall be placed to 95% Modified Proctor.

Soil, which is unsuitable for backfill, such as clay or other unsuitable materials, shall be removed to a depth of six (6) inches below the bottom of the pipe and shall not be used to backfill the trench, but shall be disposed of as directed by the Landscape Architect. The trench shall be backfilled with a granular material. Material which is unsuitable for backfill shall include rock excavation, boulders of one cubic foot or more, broken structures of any kind, frozen material, clay, tree roots and other vegetable or organic materials and debris or refuse of any kind.

Removal of clay and replacement of granular fill in sewer, and sewer lateral trenches, where required, shall be incidental to price bid for furnishing and laying of pipe, and no extra compensation will be allowed.

All pipe shall be carefully laid in the prepared trench, bells up grade, with spigot end fully entered into the adjacent bell, each section having a firm bearing throughout its entire length and true to line and grade required.

Lay all tile with a smooth and uniform invert grade.

Any pipe which is not in true alignment or which shows any settlement shall be taken up and relaid.

No broken or cracked pipe shall be used.

No sewer pipe shall be laid on loose materials, clumps of material, or on debris of any kind.

The Contractor shall provide all necessary barricades and sheet piling to protect the public, his employees and the work.

Adjust existing sewer frames as required for new paving. Provide temporary closures over openings until completion of rolling operations. Remove closures at completion of the work. Set cover frames to grade, flush with surface of adjacent pavement.

The Contractor shall make an accurate record of all stub ends installed, noting exact locations, depth, direction of flow and where applicable, slope. Final "As-Builts" shall be turned over to the Owner and Landscape Architect upon final acceptance.

TECHNICAL SPECIFICATIONS
LAWN SEEDING - SECTION 02910

PART I - GENERAL

1.01 **Description**

This work consists of the complete construction of all lawn areas as indicated on the plans or disturbed during construction, including the finish grading, tilling and cleaning the seed bed; seeding; fertilizing; mulching; weed control; specified watering; and maintaining the seeded areas through the required mowings.

1.02 **Submittals**

Provide product data or test and Evaluation reports for each type of product indicated.

A. Grass Seed
B. Hydro-mulching
C. Tackifier
D. Straw/Coconut Fiber
E. Fertilizer

PART II - PRODUCTS

2.01 Grass seed shall be applied at the rate of six pounds (6#) per thousand square feet in the following mixture.

SEED	PERCENT/ WEIGHT	MINIMUM PERCENT GERMINATION
Merit Kentucky Bluegrass	10%	85%
Monopoly Kentucky Bluegrass	10%	85%
Touchdown Kentucky Bluegrass	10%	85%
Manhattan II Perennial Ryegrass	25%	85%
Fiesta II Perennial Ryegrass	25%	85%
Pennlawn Creeping Red Fescue	20%	85%
	100%	

2.02 Mulch for hydro-mulching shall be commercially available wood cellulose fiber or wood pulp for use in spray applicators and shall be applied at a rate of 1,250 pounds per acre. All seed areas must be completely and uniformly covered.

2.03 Tackifier for mulch shall be GeoPro Matrix as available from Price & Company, Inc., telephone 1-800-248-8230.

2.04 Straw/Coconut fiber combination blanket shall be by North American Green, number SC150BN, as available from Price & Company, Inc., telephone 1-800-248-8230.

2.05 Fertilizer 10-10-10 or 12-12-12

PART III - EXECUTION

3.01 **Seeding Operations**

The Contractor shall till; fine grade; remove all sticks, stones, debris, clay lumps, sod clods and other undesirable materials in the top four (4") inches of soil and have the Landscape Architect approve the seed bed before seeding.

After the seedbed has been prepared and approved by the Landscape Architect, the Contractor shall sow the specified seed mixture with a Brillion, or equal, mechanical seeder.

The Contractor shall incorporate an equal ratio, complete fertilizer such as 10-10-10 or 12-12-12 in the top two inches (2") of soil or in the hydro-slurry mix at a rate of four hundred pounds per acre (400#/acre).

After the seed is installed the entire seedbed area shall be hydro-mulched as specified. All seed areas must be completely and uniformly covered. Light and uneven areas will not be accepted. Care should be taken to prevent overspray of mulch on curbs, walks, pavement, etc. All overspray must be cleaned off.

For slopes of 5 on 1 (20%) or greater, the contractor shall incorporate GeoPro Matrix in combination with hydroseeding at a rate of 2000 lbs per acre. GeoPro Matrix is available through Price & Company, Inc., telephone 1-800-248-8230.

For slopes of 4 on 1 (25%) or greater and all drainage swales, the contractor shall cover the entire area with the straw/coconut combination blanket in accordance with the manufacturer's recommendations.

3.02 **Season of Seeding**

The normal seasonal dates for seeding shall be August 20 through October 10 and April 15 to May 25. The Landscape Architect may approve seeding of irrigated areas outside of these dates. The Landscape Architect must approve seeding at other times of the year. Seeding shall not be done when the ground is excessively wet, frozen or otherwise intillable.

3.03 **Repairs**

The Contractor shall be responsible for the repair of any damage to existing lawns, which may result from his work and such repairs shall be made swiftly in a thorough and workmanlike manner, with minimum inconvenience to the Owner and users of the

site. Repairs shall be made to the satisfaction of the Landscape Architect.

Where lawn areas have been disturbed or damaged, the damaged lawn areas, ruts and depressions shall be cultivated, filled with topsoil, settled to proper grades and seeded to the satisfaction of the Landscape Architect.

3.04 **Maintenance**

This work consists of all labor, equipment, materials and means necessary to completely nurture, cultivate, sustain, care for or otherwise maintain all seeded lawn areas including additional fertilization and weed control as required to achieve as thick, healthy weed free turf.

All seeded lawn areas shall be maintained by the Contractor for a period of sixty (60) days following germination and for at least three (3) complete mowings.

A. **Lawn Mowing**

The first mowing shall occur when the grass is approximately 3½ inches in height. Mowings shall occur when the grass is within ¼ inch of 3 inches in height. Cut grass 2 inches to 2½ inches high. Not more than 1/3 of the height of the grass shall be removed in any single cutting.

All mowing shall be done with clean, freshly sharpened and properly adjusted rotary or reel type mowing equipment of reputable make and design. Mowing is not permitted when the grass blades are wet. Clippings shall be left if the grass is cut within the specified heights. Cuttings of more than 1/3 of the height shall have all clippings removed. Mowing direction should be varied with each mowing to change the patterns of wear and cut. All edge areas shall be cleanly trimmed to the same height as the rest of the lawn area.

All walks, ground cover beds, parking areas, drives and related areas shall be free of clippings or related mowing and maintenance waste before mowing is considered complete and before the Contractor leaves the job site.

B. **Lawn Watering**

Watering shall occur on a regular basis throughout the maintenance period and shall be adjusted to include natural rainfall if ½ inch or more falls in a two consecutive day period.

All lawn areas shall receive at least 1½ inches of water per week in porous soils and 1 inch of water in clay soils. One inch (1") of water is approximately 640 gallons of water per 1,000 square feet of lawn. Water shall be applied in not more than two equal applications per week in any given area to ensure complete and thorough wetting of the soil and root systems. Frequent, light waterings shall not be permitted.

If an irrigation system is available, the contractor shall be responsible for its complete operation during the maintenance period.

Care shall be taken to water all areas equally by adjusting rates of application required for different soils and exposure conditions.

Every effort shall be made to water from early morning to approximately one (1) hour before mid-day. Watering during the mid-day period or during very high winds shall not be permitted without expressed approval by the Owner.

The Contractor shall furnish and/or arrange for with the Owner, all equipment and materials necessary to properly conduct all watering operations in a timely, efficient and orderly manner.

The Owner shall make available all equipment, facilities, access and water necessary for the Contractor to connect to, control, locate or otherwise utilize to achieve the specified rates and schedules for lawn watering.

The Contractor shall utilize all existing water services and irrigation systems; in the manner they were intended, to uniformly and thoroughly water all lawn areas. Spray from watering devices shall not be directed across walks, drives or parking areas or against buildings, except by expressed approval from the Owner.

Rotation of watering areas shall be in an organized, orderly manner with every effort made to completely water physically contiguous areas.

All watering shall be by spray application at rates that permit continuous absorption without puddling or flowing off-site or into other areas. Flood watering will not be permitted.

3.05 Satisfactory Turf

A. Turf installations shall meet the following criteria as determined by Owner:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

SECTION 331113 – SITE WATER DISTRIBUTION PIPING

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 water-distribution piping outside the buildings for water service mains.

B. Related Sections:

1. Division 31 Section “Erosion and Sedimentation Controls” for technical requirements governing required erosion and sedimentation control measures for areas disturbed by water distribution piping construction.
2. Division 31 Section “Selective Clearing” for technical requirements governing removal of existing concrete curbs and sidewalks required by sanitary sewer construction.
3. Division 32 Section “Concrete Paving” for technical requirements governing replacement of concrete removed by water distribution piping construction.
4. Division 32 Section “Turf and Grasses” for technical requirements governing subgrade preparation, topsoil placement, fertilization, seeding and maintenance of lawn areas disturbed by water distribution piping construction.

1.3 DEFINITIONS

A. ANSI: American National Standards Institute.

B. ASTM: American Society for Testing and Materials.

C. AWWA: American Water Works Association.

D. MDOT: Michigan Department of Transportation

E. DTMB: Michigan Department of Technology, Management & Budget

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Operation and Maintenance Data: For water valves to include operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with the requirements of the City of Muskegon Department of Public Works and City of Muskegon Watermain Specifications.
2. Comply with the standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Bacteriological test results. Provide the original reports of samples analyzed for bacteriological contamination at a laboratory certified by the Michigan Department of Public Health.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves 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 according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Support off the ground or pavement in watertight enclosures.

C. Handling: Use sling to handle valves 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. Protect stored piping from moisture and dirt. Elevate above grade.

E. Protect flanges, fittings, and specialties from moisture and dirt.

1.7 PROJECT CONDITIONS

A. The location of existing underground utilities shown on the site plans are approximate and have been determined from information provided by others. The Contractor shall be responsible for verification and location of all underground utilities and structures as well as coordination with all respective public and private utility owners prior to excavation activity.

1.8 COORDINATION

A. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall. All work within 5’ of building to be completed by licensed plumber.

B. Notify City of Muskegon Department of Public Works no fewer than two business days in advance of proposed tapping of existing water mains. Do not proceed with the work unless authorized in writing by the City of Muskegon Department of Public Works.

PART 2 - PRODUCTS

2.1 WATER SERVICE MATERIALS

A. Service Lines: Shall be in accordance with ASTM B-88, Type "K" annealed, seamless copper. The service shall be connected to the corporation cock and "goose-necked" for expansion purposes, with a minimum of 5 ½ feet of bury below the proposed grade.
B. Copper to Copper Connection
   1. 74758-22 by A.Y. McDonald Mfg. Co
   2. C 22-xx-nl, CS 22-xx-nl, C 44-xx-nl by The Ford Meter Box Company, Inc.
   3. or Engineer approved equal.
C. Corporation Cock – The corporation cock shall be a Mueller # P25008, Ford # FB1000-X pack joint or approved equal. On services 1 ¼" to 2" a ductile cast iron saddle Ford # FS101 or approved equal shall be used.
D. Curb Stop and Box - The curb stop shall be a Mueller #P25155, Ford #B44-444M pack joint or approved equal with a 2 inch Minneapolis threaded top, bushed for 1.5 inch thread. Connections shall be copper pipe to copper pipe.

2.2 PIPE BEDDING, INITIAL BACKFILL AND TRENCH BACKFILL

A. Pipe bedding, initial backfill and trench backfill shall meet the current MDOT requirements.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. General:

1. Do not use deformed, defective, gouged, or otherwise damaged pipes or fittings.
2. Keep trench free of water. Clean pipe interior prior to placement in the trench.
3. Install pipe with fittings and valves to the lines and grades specified in the contract documents.
4. Clean joint surfaces thoroughly and apply lubricant approved for use with potable water and recommended by the manufacturer.
5. Push pipe joint to indication line on spigot end of pipe before making any joint deflections.
6. Limit joint deflections to one degree less than pipe manufacturer's recommended maximum limit.
7. Tighten bolts in a joint evenly around the pipe.
8. Keep exposed pipe ends closed with rodent-proof end gates at all times when pipe installation is not occurring.
9. Close the ends of the installed pipe with watertight plugs during nights and non-working days.
10. Do not allow any water from the new pipeline to enter the existing distribution system piping until testing and disinfection are successfully completed.
11. Apply polyethylene encasement to all ductile iron pipe, valves and fittings.
12. Set tops of frames and lids to finish grade unless otherwise directed by the Owner.
13. Check the working order of all valves by opening and closing through the entire range. Before opening the valves, check with the Owner on operating requirements.

14. Provide 5’6” cover to the top of pipe from the established or proposed gutter grade (6 feet from the top of curb).

3.2 CONFLICTS

A. Protect all existing utilities, service lines, and related structures encountered in the excavation work. Provide temporary support for existing gas, telephone, power, or other utilities or services that cross the trench. Repair damage to existing utilities, service lines, and related structures immediately at no cost to the Owner or the utility owner.

B. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.

2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:

a. Local conditions prevent a lateral separation of 10 feet (3 m); and

b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.

C. Vertical Separation - Water Mains and Sewers at Crossings

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 18 inches above the crown of gravity flow sewer. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.

2. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

3.3 TESTING AND DISINFECTION

A. Pressure test water mains per City of Muskegon Department of Public Works Standards. Where it is not practicable to pressure test the connections to existing mains, a visual inspection shall be carried out under normal working pressure before backfilling the trench. Any noticeable leakage shall be stopped, and any defective pipe or fittings shall be replaced with new material.

B. After the successful completion of the pressure testing, flush and disinfect the water main per City of Muskegon Department of Public Works Standards.

C. Following chlorination, perform final flushing and testing of the line per City of Muskegon Department of Public Works Standards.

END OF SECTION 331113

SECTION 333000 – SANITARY SEWER UTILITIES

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. Related Sections

1. Division 31 Section “Erosion and Sedimentation Controls” for technical requirements governing required erosion and sedimentation control measures for areas disturbed by water distribution piping construction.
2. Division 31 Section “Selective Clearing” for technical requirements governing removal of existing concrete curbs and sidewalks required by sanitary sewer construction.
3. Division 32 Section “Concrete Paving” for technical requirements governing replacement of concrete removed by sanitary sewer construction.
4. Division 32 Section “Turf and Grasses” for technical requirements governing subgrade preparation, topsoil placement, fertilization, seeding and maintenance of lawn areas disturbed by sanitary sewer construction.

1.3 REFERENCE SPECIFICATIONS

A. Michigan Department of Transportation (MDOT), "Standard Specifications for Construction", current edition.

B. American Society for Testing and Materials (ASTM), latest edition.

1.4 DEFINITIONS

A. ANSI: American National Standards Institute.

B. ASTM: American Society for Testing and Materials.

C. AWWA: American Water Works Association.

D. MDOT: Michigan Department of Transportation.

1.5 ABBREVIATIONS

A. PVC: Polyvinyl chloride plastic

B. DI: Ductile iron pipe

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.

B. Handle manholes according to manufacturer's written rigging instructions.

1.7 COORDINATION

A. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall. All work within 5’ of building to be completed by licensed plumber.

B. Notify City of Muskegon Department of Public Works no fewer than two business days in advance of proposed tapping of existing sanitary sewer. Do not proceed with the work unless authorized in writing by the City of Muskegon Department of Public Works.

1.8 Quality Assurance**:**

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.

2. A nameplate bearing the manufacturer’s name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Regulatory Requirements:

1. Comply with the requirements of the City of Muskegon Department of Public Works.

1.9 SUBMITTALS**:**

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and, Appurtenances.

2. Jointing Material.

3. Manhole and Structure Material.

4. Frames and Covers.

1.10 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

C478-09	Precast Reinforced Concrete Manhole Sections
C857-11	Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
C890-11	Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
C913-08	Precast Concrete Water and Wastewater Structures
C1173-10	Flexible Transition Couplings for Underground Piping Systems
C1461-08	Mechanical Couplings Using Thermoplastic Elastomeric (TPE) Gaskets for Joining Drain, Waste and Vent (DWV), Sewer, Sanitary and Storm Plumbing systems for Above and below Ground Use
D2321-11	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D3034-08	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
F477-10	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
F949-10	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
F1417-11	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
F1668-08	Construction Procedures for Buried Plastic Pipe

1.11 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

B. The Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PVC, GRAVITY SEWER PIPE AND FITTINGS

A. PVC Gravity Sewer Piping:

1. All sewer laterals shall be extra strength pipe. Any specified bends or curves shall be smooth, long-radius type curves. No mitered or segmental type bends will be approved.

2. Polyvinyl chloride (PVC) solid-wall pipe less than 18 inches in diameter shall conform to the requirements of ASTM Designation D3034, with a standard dimension ratio of 35 (SDR-35).

3. Extra strength pipe shall conform to the requirements of ASTM Designation D3034, with a standard dimension ratio of 26 (SDR-26). Extra strength pipe shall be required for installations over 18 feet deep based on the average depth of the manholes for each section of pipe.

4. Joints shall be flexible elastomeric sealed type joint in accordance with ASTM D3212.

5. Gaskets: ASTM F477.

6. Wyes and Tees: Wyes and Tees may be cast fittings of the same material and joints as the main sewer, or may be an approved fabricated special fitting which provides a suitable connection for the lateral to the main sewer. Details of special fittings and/or adapters for connecting laterals of a material different from the main sewer shall be approved by the Engineer before they are manufactured. Wyes and Tees will be required as follows: 6" Wyes on main sewer of 8" or 10" diameter, 6" Wyes or Tees on main sewer of 12" diameter or larger, and 6" Inserta-Tee, or approved equal, on main sewer of 24" diameter or larger.

2.3 NONPRESSURE-TYPE TRANSITION PIPE COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F477, elastomeric seal.

2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Couplings shall be elastomeric sleeve with stainless steel shear ring.

D. Shielded, Flexible Couplings:

1. Couplings shall meet ASTM C1460 with elastomeric with full- length, corrosion-resistant outer shield with corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger mainline pipe and for spigot of smaller main line pipe to fit inside ring.

2.4 CLEANOUTS

A. PVC Cleanouts:

1. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.

2. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

B. Cleanout Casting: EJ 1570

2.5 WARNING TAPE

A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape non-detectable type, green with black letters and imprinted with “CAUTION BURIED SEWER LINE BELOW”.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.

E. Inspect pipes and fittings for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.

F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

G. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.

H. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe

I. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

J. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

K. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.

L. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.

2. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.
3. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.2 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure, drainage piping according to the following:

1. Join ductile iron, gravity sewer piping according to AWWA C600 for push-on joints.

2. Join PVC piping according to ASTM D2321.

3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.

B. Join force-main, pressure piping according to the following:

1. Join ductile iron pressure piping according to AWWA C600 for push-on joints.
2. Join PVC pressure piping according to manufacturer's recommendations.
3. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.

A. Flexible couplings for pipes of same or slightly different OD.

B. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

C. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.3 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES WITHIN VAULTS

A. Install reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.4 BUILDING SERVICE LINES

A. Install sanitary sewer service lines to point of connection within approximately 5 feet (1500 mm) outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines. All work within 5 feet of building to be done by licensed plumber.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Cleanouts should be 6 inches (150 mm) in diameter and consist of a ductile iron 45 degree fitting on end of run, or combination Y fitting and l/8 bend in the run with ductile iron pipe extension, water-tight plug or cap and cast frame and cover flush with finished grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Casting as specified on drawings.

B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches (450 by 450 by 300 mm) 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement

surface.

D. The top of the cleanout assembly shall be 2 inches (50 mm) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.6 CONNECTIONS

A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe and grout the interstitial space between the pipe and the core.

B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.

C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.

2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete to provide additional support of collar from connection to undisturbed ground.

3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 PIPE SEPARATION

A. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.

2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:

A. Local conditions prevent a lateral separation of 10 feet (3 m); and

B. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.

3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 18 inches above the crown of gravity flow sewer. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.

2. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.

3. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

3.8 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edges of underground manholes.

3.9 FIELD QUALITY CONTROL

A. All systems shall be inspected and obtain the Resident Engineer's approval. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.

1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:

A. Alignment: Less than full diameter of inside of pipe is visible between structures.

B. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

C. Damage: Crushed, broken, cracked, or otherwise damaged piping.

D. Infiltration: Water leakage into piping.

E. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Re-inspect and repeat procedure until results are satisfactory.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

1. Test plastic gravity sewer piping according to ASTM F1417.

2. Test concrete gravity sewer piping according to ASTM C924.

3. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.

4. For force mains, perform testing after supports and anchors are installed. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psi (1035 kPa).

5. Testing of Fiberglass Sewage Holding Tanks shall show no leakage during a 5 psi (35 kPa) air pressure test with 5:1 safety factor.

6. Testing of Concrete Wet Well shall show no leakage with the wet well completely filled with water for a duration of 4 hours.

3.10 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 333000

TECHNICAL SPECIFICATIONS
ELECTRICAL BASIC MATERIALS AND METHODS - SECTION 16050

PART I - GENERAL

1.01 **WORK INCLUDED**:

A. Electrical basic requirements.

B. Existing work.

C. Connection of utilization equipment.

D. Supports.

1.02 **RELATED REQUIREMENTS**:

A. General Conditions.

1.03 **REGULATORY REQUIREMENTS**:

A. Conform to Michigan State Electrical Code, State Electrical Administrative Board and State Fire Marshall requirements.

B. Conform to National Electrical Code, NFPA 70, where not in conflict with State requirements.

C. Obtain permits, and certified inspection and approval from State Electrical Administrative Board and local authority having jurisdiction.

1.04 **PROJECT CONDITIONS**:

A. Verify field measurements and circuiting arrangements are as shown on drawings.

B. Report discrepancies to Architect/Engineer before disturbing existing installation.

1.05 **QUALITY ASSURANCE**:

A. Perform work to requirements of NECA Standard of Installation.

B. Use personnel with appropriate experience to perform work on energized equipment and circuits.

C. Review submittals for equipment furnished under other Sections, prior to

installation and electrical rough-in. Verify location, size and type of connections. Coordinate details of equipment connections with supplier and installer.

D. All Materials: Obtain approval from Architect/Engineer in writing, before order for material is placed, and conform with the standards of the Underwriters Laboratories, Inc. in every case where such a standard has been established for the type of material in question.

E. Provide three copies of affidavits acceptable to the State Fire Marshall which provide proof from a nationally recognized testing laboratory that each fixture used on the project meets the requirements of the letter issued by the Fire Safety Board titles "Tentative Guidelines for Use of Formed Plastic Materials".

F. At completion of the work, furnish to the Architect/Engineer, for Owner, three bound operating instructions, wiring diagrams, project record drawings, and certificates of inspection.

G. Guarantee/Warranty:

1. Guarantee products one (1) year minimum free from mechanical defects in manufacture.

2. Warranty workmanship one (1) year free from defects.

1.06 **SUBSTITUTIONS**:

A. No substitutions of equipment will be permitted where specific trade names or manufacturers are referenced, unless written approval is given by Architect/Engineer, such requests for approval will indicate difference in price, if any.

PART II - PRODUCTS

2.01 **BASIC MATERIALS:**

A. Steel Channel: Galvanized or painted steel.

B. Miscellaneous Hardware: Treat for corrosion resistance.

C. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

D. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

E. Expansion Shields: Tapered nut type with lead alloy expansive retainer sleeve.

PART III - EXECUTION

3.01 **INSTALLATION**:

A. Make electrical connections to utilization equipment in accordance with equipment manufacturer's instructions.

1. Verify that wiring and outlet rough-in work is complete and that utilization equipment is ready for electrical connection, wiring and energization.

2. Make wiring connections in control panel or in writing compartment of pre-wired equipment. Provide interconnecting wiring where indicated.

3. Install and connect disconnect switches, controllers, control stations, and control devices as indicated.

4. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit.

5. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

6. Install pre-fabricated cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain relief clamps.

7. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

B. Install support systems sized and fastened to accommodate weight of equipment and conduit, including wiring, which they carry.

1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, or other fastener approved for application.

2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in wood construction.

3. Do not fasten supporters to piping, ceiling support wires, ductwork, mechanical equipment, or conduit.
4. Do not use powder-actuated anchors.

5. Do not drill structural steel members.

6. Fabricate supports from structural steel or steel channel, rigidly welded or bolted.

7. Install surface-mounted cabinets and panelboards with minimum of four anchors.

8. Provide steel channel supports to stand cabinets 1" off wall in wet locations.

9. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

C. Identify electrical distribution and control equipment, and loads served, to meet regulatory requirements and as indicated.

1. Degrease and clean surfaces to receive nameplates and tape labels.

2. Secure nameplates to equipment lines. Secure nameplate to inside face of recessed panelboard doors in finished locations.

3. Use nameplates with 1/8" lettering to identify individual switches and circuit breakers, wall switches, receptacle circuits and loads served.

4. Use nameplates with ¼" letters to identify distribution and control equipment.

5. Install wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connections.

6. Use branch circuit or feeder number to identify power and lighting circuits.

7. Use control wire number as indicated on equipment manufacturer's shop drawings to identify control wiring.

3.02 **ADJUSTING AND CLEANING**:

A. Touch up electrical equipment finishes at completion of work.

B. Clean lighting fixture lenses and reflecting suffices at completion of work.

C. Leave work in clean condition, as approved by Owner.

END OF SECTION

TECHNICAL SPECIFICATIONS
CONDUIT - SECTION 16111

PART I - GENERAL

1.01 **WORK INCLUDED**:

A. Rigid Metal Conduit and Fittings (RGS).

B. Electrical Metallic Conduit and Fittings (EMT).

C. Liquid-tight Flexible Metal Conduit and Fittings.

D. Non-metallic Conduit and Fittings.

1.02 **RELATED SECTIONS**:

A. Section 01045 - Cutting and Patching.

1.03 **REGULATORY REQUIREMENTS**:

A. Comply with UL Listing and labeling for grounding on all components.

1.04 PERFORMANCE REQUIREMENTS:

A. Test and complete electrical continuity to ground from all boxes, fittings and cabinets.

PART II - PRODUCTS

2.01 **MATERIALS**:

A. Rigid Metallic Conduit (RGS):

1. Steel only (aluminum not acceptable)

2. Hot-dipped galvanized.

3. Acceptable Manufacturers:

a. Youngstown Sheet and Tube

b. Triangle Industries

c. Republic Steel

d. Steelduct

e. Pittsburgh Standard

4. Fittings and Conduit Bodies:

a. Threaded Type

b. Materials to match conduit

3. Manufacturers:

a. Crouse Hinds Form 7

b. Appleton FM7

B. Electrical Metallic Tubing (EMT):

1. Steel only (others not acceptable).

2. Hot-dipped galvanized.

3. Acceptable Manufacturers:

a. Youngstown Sheet and Tube

b. Triangle Industries

c. Republic Steel

d. Steelduct

e. Pittsburgh Standard

f. GE White

4. Fittings and Conduit Bodies:

a. Compression type only (set screw type not acceptable).

b. Material to match conduit.

C. Liquid-tight Flexible Metal Conduit:

1. Flexible metal conduit with PVC jacket.

2. Acceptable Manufacturers:

a. Anaconda Type UA.

b. Appleton Liquidtite.

3. Fittings and Conduit Bodies:

a. Material to match conduit.

b. Connectors:

1. Straight connectors only.

2. Standard and Class 1, Division 2 areas.

3. Appleton Series ST.

4. 40Z Gedney Groundtite.

4. Equipment Bonding Jumper (Refer to Section 16120 - Wire & Cable).

D. Rigid Non-metallic Conduit:

1. PVC.

2. Schedule 40.

3. Fittings and Conduit Bodies:

a. Materials to match conduit
b. Elbows for >3/4” shall be PVC coated RGS.

4. Acceptable Manufacturers:

a. Carlon

b. Robroy

c. Pyle-National Division

E. Fittings:

1. Match conduit system type used.

2. Factory elbows:

   a. Standard 1 ¼" - 2 ½" sizes.

   b. Long Radius: 3" and larger sizes.

3. Couplings: Erickson type.

4. Gaskets: Solid type for sizes 1 ½" and smaller

5. Unions: Crouse Hinds type UNY.

6. Corrosion Resistant Sealant: Dow Corning Sealant #3145 RTV.

7. Bushings: Insulating type.

8. Clamps:

   a. Galvanized malleable iron type.

   b. R.C. (right angle).

   c. E.C. (edge).

   d. P.C. (parallel).

   e. Cable Tray: Crouse Hinds LCC series.

9. Pipe Straps:

   a. Galvanized malleable iron type.

   b. One hole style for conduit sizes 1 ½" and smaller.

   c. Two hole style for conduit sizes 2" and larger.

10. Cable and tubing fittings: Crouse Hinds type CGB with Neoprene bushings.

11. Drains and Breathers: Crouse Hinds ECD for Class 1, Division 2 areas.

12. Masonry wall anchors: Lead machine bolt type.

PART III - EXECUTION

3.01 **PREPARATION**:

A. Plan precise routing; drawings show conceptualized routing only.

B. Install floor sleeves and slots.

1. Steel pipe sleeves two sizes larger than conduit.

2. Slots with 4” continuous toe plates.

3. Allow space for 50% future use.

3.02 **INSTALLATION**:

A. Sizing:

1. Size conduit for conductor type installed (or for type THW conductors, whichever is larger); ¾” minimum, except for device fixture leads at ½” minimum.

B. Routing:

1. Run exposed, except as specifically directed.

2. Parallel and perpendicular to building lines.

3. Provide space for 50% future conduit.

4. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.

C. Clearances:

1. Hot Pipes and Surfaces: 6” minimum.

2. Aisleways and Passageways: 8’ minimum vertically above floor.

3. Covers on Fittings and Pull Boxes: Orient for ease of accessibility and maintenance.

D. Ground at terminations.

E. Bond to cable tray.

F. Use liquid-tight flexible metallic conduit:

1. At motor connections

2. At equipment subject to vibration

3. Where flexibility is required.

4. Minimum length: 18”

5. Maximum length: 6’

G. Provide expansion fittings where crossing expansion joints in building construction.

H. Provide structural support to ensure rigidity.

1. Arrange conduit supports to prevent distortion of alignment by wire pulling operations.

2. Fasten conduit using:

a. Pipe straps against flat surface with ¼” back strap.

b. Clamps.

c. Lay-in adjustable hangers.

d. Clevis hangers.

e. Bolted split stamped galvanized hangers.

f. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction before conductors are pulled.

3. Provide support within 1’ of conduit fittings control stations.

4. Do not support from piping or insulated equipment.

5. Fabrication of supports:

    a. From steel bar, angle, or channel.

    b. Uni-Strut type materials may be used in indoor, non-corrosive areas.

    c. Do not form pockets which can hold liquids.

6. Do not cut or drill structural steel.

    a. Exception by prior Owner approval only.

I. Fabrication:

1. Field bends:

    a. Prevent injuries to conduit.

    b. Prevent effective reduction in internal diameter.

    c. Make field bends uniform throughout system.

    d. 90° maximum.

    e. Verify minimum cable bending radius acceptable.

2. Cut conduit ends square and deburr.

3. Threading:

    a. Use minimum number of threads required.

    b. Running threads are not acceptable.

    c. Remove all cutting oil prior to installation.

    d. Coat exposed threads with acid resistant cold galvanizing treatment to prevent corrosion.

4. Conduit joints: Draw up tight to shoulder to assure solid connection.

5. Offset bends: Two maximum between pull boxes.

6. Conduit drains: Provide wherever water is likely to collect.

7. Unions:

    a. Locate between conduit seals and electrical devices requiring seals.

    b. Locate at motor or equipment end of flex conduit so motor may be removed without removing bonding jumper.

8. Screw threads on fittings and boxes:

    a. Coat for corrosion prevention with one of the following:

        1. Molykote

        2. Graphite Grease

        3. Never Seize

9. Install two locknuts and a bushing on conduits which terminate in cabinets or pressed steel boxes.

10. Install bushings and CGB type cable fittings at conduit ends where wiring or pneumatic tubing only extends to electrical device.

11. PVC Conduit:

    a. Wipe plastic clean and dry before joining.

    b. Apply full even coat of cement to entire area of joint.

    c. Let joint cure 20 minutes minimum after joining.

J. Provide suitable conduit caps to protect installed conduit against entrance of dirt and moisture at end of each work period.

K. Provide suitable pull string in empty conduits.

END OF SECTION

TECHNICAL SPECIFICATIONS
WIRE AND CABLE – SECTION 16120

PART I - GENERAL

1.01 **WORK INCLUDED**:

A. Building Wire.

B. Wiring Connections and Terminations.

1.02 **REFERENCES**:

A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

1.03 **SUBMITTALS**:

A. Submit shop drawings and product data under the provisions of General Conditions.

B. Submit manufacturer's instructions.

PART II - PRODUCTS

2.01 **MATERIALS**:

A. Building Wire:

1. All wire shall be single conductor, multi-strand, copper, rated for 600 volts, with NEC insulation type as specified below:

Wire Size	NEC Type Rating	Temperature Criteria	Selection
#14-#8	AWGTHWN or THHN	75° C	Preferred
	THW or XHHW	75° C	2nd
For run over 200'	XHHW	75° C	Preferred
#6 - 500 MCM	XHHW	75° C	Preferred

THW	75° C	2nd
THWN or THHN	75° C	3rd

2. Wire shall be color-coded as follows:

   a. 600 volt, 3 phase, power conductor shall be BLACK.

   b. 120/240 Volt, 3 phase, 4 wire, grounded delta

      1. Neutral conductor: WHITE

      2. Phase x conductor: BLACK

      3. Phase y conductor: RED

      4. Phase z conductor: BLUE

      5. Wild leg: Marsh with an ORANGE tape.

   c. In addition, wires shall have numbers tape affixed to each conductor with lighting circuit or wire number in accordance with the drawings. The numbers shall appear at each electrical device.

B. Wire Connectors:

1. T & B Sta-kon

2. Burndy HY tape

C. Insulators for 600 volt or less:

1. Splicing

2. Terminating

3. 3M Scotch 33 Plus

4. T & B PT-66M

D. Wire Pulling Lubricant: UL Approved Required.

E. Cable Ties:

1. Indoors: Sunlight resistant Plastic T & B Ty-raps

2. Outdoors: Sunlight resistant Plastic T & B Ty-raps

F. Connectors:

1. Crimp type connectors

2. Wire nuts:

a. Used only in lighting fixtures

G. Equipment Bonding Jumpers:

1. Size per NEC-250

2. Copper

3. THWN type, green insulation

4. Minimum size #12 AWG.

PART III - EXECUTION

3.01 INSTALLATION:

A. Install wire in a single continuous length from termination to termination.

B. Use no splices:

1. Exception: 120 VAC and other wiring where approved.

C. Terminations: Install maximum 3 wires per terminal.

D. Use minimum wire sizes:

1. Receptacles and lighting circuits: No. 12 AWG

2. Motor and control wiring: No. 14 AWG.

END OF SECTION

TECHNICAL SPECIFICATIONS
ELECTRICAL IDENTIFICATION – SECTION 16195

PART I - GENERAL

1.01 **SUMMARY**:

A. Tagging Requirements:

1. Temporary

2. Permanent

a. Electrical Circuits

b. Instrument Circuits

c. Wire Identification

d. Electrical Equipment

1.02 **DEFINITIONS:**

A. Temporary Tagging: Used during construction.

B. Permanent Tagging: Used after construction.

PART II - PRODUCTS

2.01 **MATERIALS**:

A. Temporary Tagging:

1. Cardboard tags with string ties:

a. Hand-written notes.

b. Permanent ink.

2. Dymo Tape Markers:

a. Self-adhesive tape.

b. 1/8” high letters

c. Blue or red tape

d. May be used for permanent marking where approved by Owner.

3. Permanent Tagging:

a. Instrument Wire Markers

1. Raychem marker sleeves.

A. Typed characters

B. or approved

B. Electrical Wire Markers:

1. Brady self-adhesive markers:

A. Pre-printed

B. Typed characters

C. or approved

2. Ziptape Rite and Wrap Markers

C. Electrical Equipment Markers:

1. Low pressure laminated plastic engraved nameplates.

2. Dymo Tape Markers where specifically approved by Owner.

3. Self-adhesive paper discs:

A. Red Color

B. ½" diameter

PART III - EXECUTION

3.01 **PREPARATION**:

A. Permanent tags:

1. Verify inscriptions with Owner prior to manufacture.

2. Where inscriptions are not shown on drawings:

a. Inscribe with tag name/number of equipment.

b. Inscribe with individual wire designation.

B. Surface Preparation:

1. Clean surface of equipment prior to installation.

3.02 **INSTALLATION**:

A. Temporary Tags:

1. Tie onto wires immediately after installation.

2. Eliminate if permanent tags are available.

B. Permanent Identification:

1. Wire Tagging:

a. Install immediately before termination.

b. Install at each end of wire.

2. Warning Signs: Install as directed in field.

3. Night Lights:

a. Apply paper disc to fixture exterior.

b. Apply disc where visible from normal walk area.

END OF SECTION

TECHNICAL SPECIFICATIONS
SECONDARY GROUNDING - SECTION 16450

PART I - GENERAL

1.01 **WORK INCLUDED**:

A. Power system grounding.

B. Electrical equipment and raceway grounding and bonding.

1.02 **SYSTEM DESCRIPTION**:

A. Bond together system neutrals, service equipment enclosures, exposes non-current carrying metal parts of electrical equipment, metal raceway system, grounding conductor in raceways and cables, receptacles ground connectors, and plumbing systems.

1.03 **SUBMITTALS**:

A. Submit shop drawings under provisions of Section 01001.

B. Indicate location of system grounding electrode connections, and routing of grounding electrode conductor.

PART II - PRODUCTS

2.01 **MATERIALS**:

A. Materials:

1. Ground Rods: Copper-encased steel, ¾" diameter, minimum length 10 feet.

PART III - EXECUTION

3.01 **INSTALLATION**:

A. Provide a separate, insulated equipment grounding conductor in feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing.

3.02 **FIELD QUALITY CONTROL**:

A. Inspect existing grounding and bonding system conductors and connections for tightness and proper installation.

B. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Notify architect and owner if resistance is greater than 10 ohms.

END OF SECTION

TECHNICAL SPECIFICATIONS
LIGHTING FIXTURES - SECTION 16510

PART I - GENERAL

1.01 **WORK INCLUDED:**

A. Exterior luminaries and accessories.

C. Lamps.

D. Ballasts.

1.02 **REFERENCES:**

A. ANSI C82.1 - Specification for fluorescent Lamp Ballasts.

B. ANSI C82.4 - Specifications for high-intensity-discharge lamp ballasts (multiple supply type).

C. FS W-F-414 - Fixture, lighting (fluorescent, alternating-current, pendant mounting).

D. NEMA LE 2 - H-I-D lighting system noise criterion (LS-NC) ratings.

1.03 **SUBMITTALS:**

A. Submit product data under provisions of General Conditions.

B. Include outline drawings, lamp and ballast data, support points, weights, and accessory information for each luminaire type.

C. Submit manufacturer’s installation instructions under provisions of General Conditions.

1.04 **DELIVERY, STORAGE AND HANDLING:**

A. Deliver products to site under provisions of Section 02760.

B Store and protect products under provision of Section 02760.

PART II - PRODUCTS

2.01 **EXTERIOR LUMINAIRED AND ACCESSORIES:**

A. Enclosures: Complete with gaskets to form weatherproof assembly.

B. Provide low temperature ballasts, with reliable starting to -20 degrees F.

2.02 **ACCEPTABLE MANUFACTURERS – LAMPS:**

A. Kim.

B. Substitutions: under provisions of Section 01001.

2.03 **LAMPS:**

A. LED lamps: Provide as part of light fixture assembly.

2.05 **FLUORESCENT BALLASTS:**

A. Fluorescent Ballasts: Electronic; see fixture schedule.

B. Nominal 430 ma lamp ballasts: Electronic.

PART III - EXECUTION

3.01 **INSTALLATION:**

A. Install lamps in luminaires and lampholders.

B. Install recessed luminaires to permit removal from below. Install grid clips.

END OF SECTION

TECHNICAL SPECIFICATIONS

BUILDING

SECTION 03 3000 - 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.
   1. Footings.
   2. Foundation walls.
   3. Slab-on-grade.

B. Related Requirements:
   1. Section 02200 "Earthwork and Grading" for excavation and fill under footings and slabs-on-grade.
   2. Section 02514 “Concrete Work” for concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

   1. Recycled Content Product Data: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

   2. Design Mixtures: 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Testing agency.

B. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement and accessories.
   4. Curing compounds.
   5. Floor and slab treatment.
   6. Bonding agents.
   7. Vapor retarders.
   8. Semi-rigid joint filler.
   9. Joint-filler strip.
   10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:
   1. Aggregates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs 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 the Owner or Owner's representative qualified according to ASTM C 1077 and ASTM E 329 for concrete installation testing.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform materials evaluation tests and to design concrete mixtures.

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.

1.8 FIELD CONDITIONS

A. 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 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.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that 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.

3. Overlaid Finnish birch plywood.

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. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: If design indicates chamfers , use wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25%.

B. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

C. Steel Bar Mats: ASTM A 184, fabricated from ASTM A 615, Grade 60, deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 1064.

E. Deformed-Steel Wire: ASTM A 1064.

F. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064, flat sheet.

H. Epoxy-Coated Rebar (where indicated): ASTM A 775/A.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. 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.

2.5 CONCRETE MATERIALS

A. 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.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I, gray, unless otherwise noted.
2. Fly Ash: ASTM C 618, Class f or C.

C. Normal-Weight Aggregates: ASTM C 33, Class3M 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: 1/3 slab thickness, nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

F. 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:
    a. Grace construction Products, W.R.Grace & Co.; DCI.
    b. Master Builders, Inc.; Rheoconcrete CNI.
    c. Euclid Chemical Co.;
    d. Or approved equal.

G. 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:
    a. Grace construction Products, W.R.Grace & Co.; DCI-S.
    b. Master Builders, Inc.; Rheoconcrete 222+.
    c. Sika Corp.; FerroGard 901.
    d. Or approved equal.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   1. Products:
      a. Fortifiber Building Systems Group; Moistop Ultra 15.
      b. Raven Industries Inc.; Vapor Block 15.
      c. Reef Industries, Inc.; Griffolyn 15 mil Green
      d. Or approved equal.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application for fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. 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. Use limited to exterior slabs.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059, 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 I and II, nonload bearing for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

   1. Cement Binder: ASTM C 150/C 150M, 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 or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 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 and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, 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 or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 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.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-furnace Slag Cement: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-furnace Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 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 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 w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum W/C Ratio: 0.50. See ACI 318.
3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: to be determined in accordance with ASTM C173.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum W/C Ratio: 0.50.See ACI 318.
3. Slump Limit: 4 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: to be determined in accordance with ASTM C173.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum W/C Ratio: 0.50. See ACI 318.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: To be determined in accordance with ASTM C 173.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116 and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch and mix concrete materials and concrete according to ASTM C94/ C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

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 B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct 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. When indicated on design details, 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.

M. Trench footing: Trench footing (earth formed) in place of formed footings and foundation walls will not be allowed.

3.2 EMBEDDED ITEM INSTALLATION

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 303.

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 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 support 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 are not 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 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.5 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting 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 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, 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.

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 during review of shop drawings.

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. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does 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 or more than 1 inch 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 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is 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 not to 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 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.

D. 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.
   2. Maintain reinforcement in position on chairs during concrete placement.
   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 derbies to form a uniform and open-textured surface plane before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1.

F. Hot-Weather Placement: Comply with ACI 301.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 20; and of levelness, F(L) 15; with minimum local values of flatness, F(F) 15; and of levelness, F(L) 10; for slab-on- grade.
3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed ¼ inch.

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.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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.

3.10 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. 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 remainder of curing period.

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. 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:
   a. Water.
   b. Continuous water -fog spray.
   c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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, 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. Use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

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.

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.

3.11 LIQUID FLOOR TREATMENT APPLICATION – To be verified with resinous flooring requirements if resinous flooring is specified as concrete floor finish in this project scope.

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 14 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.

3.12 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 joints clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 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 1-part portland cement to 2-1/2 parts fine aggregate passing a No. 16 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 in any dimension to solid concrete. Limit cut depth to 3/4 inch. 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 matches 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 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 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 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 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 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 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.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Verification of use of required design mixture.
2. Steel reinforcement placement, and welding.
3. Verification of concrete strength before removal of shores and forms from beams and slabs.
4. Curing procedures and maintenance of curing temperature.

C. 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 25 cu. yd., plus one set for each additional 50 cu. yd. 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/C 231M, 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.

4. 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.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    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.

5. Additional Tests: Testing and inspecting agency shall make additional test of concrete when test results indicate that slump, air entrainment, comprehensive 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 a directed by Architect.
6. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
7. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

END OF SECTION

SECTION 04 0120 - MAINTENANCE OF EXISTING UNIT MASONRY

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 maintenance of unit masonry consisting of brick clay masonry restoration and cleaning as follows:
   1. Repairing unit masonry, including replacing damaged units and patching where wall mounted items were removed.
   2. Reanchoring masonry unit veneer as needed for secure attachment.
   3. Repointing mortar joints where depth is in excess of ½' from unit exterior face.
   4. Replacement of existing glass block with new obscured vision glass block including furnishing and installing prefinished metal brick mold casing at exterior of existing opening to achieve best fit.
   5. Furnishing and installation of new cast stone sills at all glass block "window" openings.
   6. Furnishing and installation of new burnish masonry unit base at perimeter of existing building.
   7. Cleaning exposed unit masonry surfaces

B. Related sections:
   1. Section 04 2200 " Unit Masonry" for type of glass block, precast stone sill and burnish block units base to match new Restroom building materials.

1.3 DEFINITIONS

A. Very Low-Pressure Spray: Under 100 psi.

B. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

C. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.

D. High-Pressure Spray: 800 to 1200 psi; 4 to 6 gpm.

E. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for application and use. Include test data substantiating that products comply with requirements.

B. Samples for Verification: For the following:

1. Each type of masonry unit to be used for replacing existing units. Include sets of Samples as necessary to show the full range of shape, color, and texture to be expected.

    a. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.

2. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.

    a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.
3. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For masonry contractor to work on previous similar masonry restoration scope projects.

1.6 QUALITY ASSURANCE

A. Restoration Specialist Qualifications: Engage an experienced masonry restoration and cleaning firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry is not sufficient experience for masonry restoration work.

1. At Contractor's option, work may be divided between two specialist firms: one for cleaning work and one for repair work.
2. Field Supervision: Restoration specialist firms shall maintain experienced full-time supervisors on Project site during times that clay masonry restoration and cleaning work is in progress. Supervisors shall not be changed during Project except for causes beyond the control of restoration specialist firm.
3. Restoration Worker Qualifications: Persons who are experienced and specialize in restoration work of types they will be performing.

B. Source Limitations: Obtain each type of material for masonry restoration (face brick, cement, sand, etc.) from one source with resources to provide materials of consistent quality in appearance and physical properties.

C. Cleaning and Repair Appearance Standard: Cleaned and repaired surfaces are to have a uniform appearance as viewed from 20 feet away by Architect. Perform additional paint and stain removal, general cleaning, and spot cleaning of small areas that are noticeably different, so that surface blends smoothly into surrounding areas.

D. Mockups: Prepare mockups of restoration and cleaning to demonstrate aesthetic effects and set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than 2 adjacent whole units or approximately 48 inches in least dimension. Erect sample areas in existing walls unless otherwise indicated, to demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement:

1) Four brick units replaced.

2. Repointing: Rake out joints in 2 separate areas , each approximately 36 inches high by 48 inches wide for each type of repointing required and repoint one of the areas.
3. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not use cleaners and methods known to have deleterious effect.
b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons.

B. Deliver other materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store sand where grading and other required characteristics can be maintained, and contamination avoided.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry restoration and cleaning work to be performed according to manufacturers' written instructions and specified requirements.

B. Repair masonry units and repoint mortar joints only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least 7 days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for masonry repair and mortar-joint pointing unless otherwise indicated:

1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 7 days after repair and pointing.

D. Hot-Weather Requirements: Protect masonry repair and mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

F. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least 7 days after completion of cleaning.

1.9 COORDINATION

A. Coordinate masonry restoration and cleaning with public circulation patterns at Project site.

1.10 SEQUENCING AND SCHEDULING

A. Order replacement materials at earliest possible date to avoid delaying completion of the Work.

B. Order sand and gray portland cement for pointing mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

C. Perform masonry restoration work in the following sequence:
1. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
2. Repair masonry, including replacing existing masonry with new masonry materials.
3. Rake out mortar from joints to be repointed.
4. Point mortar and sealant joints.
5. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
6. Clean masonry surfaces.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick: Facing brick complying with ASTM C 216.

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. Basis-of-design product: Contractor to submit to Architect samples of brick matching existing in appearance. Following information regarding grade, type is exemplary for bidding and shall be verified in field.

2. Grade: SW.
3. Type: FBA.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.

5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Size (Actual Dimensions): modular brick. Existing brick size to be verified in field.
7. Application: Use where brick is exposed unless otherwise indicated.
8. Color and Texture: Match existing brick.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, white or gray or both where required for color matching of exposed mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Factory-Prepared Lime Putty: ASTM C 1489.

D. Quicklime: ASTM C 5, pulverized lime.

E. Mortar Sand: ASTM C 144 unless otherwise indicated.

1. Color: Provide natural sand of color necessary to produce required mortar color.
2. For pointing mortar, provide sand with rounded edges.
3. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

F. Mortar Pigments: Natural and synthetic iron oxides, compounded for mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.3 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

1. Products: Subject to compliance with requirements, provide the following:
   a. PROSOCO; Sure Klean Restoration Cleaner or Sure Klean Restoration Heavy Duty Cleaner . Basis of Design product, or as approved equal by Architect prior to bids.

2.4 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

1. Products: Subject to compliance with requirements, provide the following:
   a. PROSOCO; Sure Klean Strippable Masking. Basis of Design product, or as approved equal by Architect prior to bids.

B. Sealant Materials:

1. Provide manufacturer's standard chemically curing, elastomeric sealant(s) of base polymer and characteristics indicated below that comply with applicable requirements in Section 079200 "Joint Sealants."

   a. Single-component, nonsag urethane sealant.

2. Colors: Provide colors of exposed sealants to match colors of masonry adjoining installed sealant unless otherwise indicated.

C. Joint-Sealant Backing:

1. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where acceptable.

D. Setting Buttons: Resilient plastic buttons, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units without intruding into required depths of pointing materials.

E. Masking Tape: Nonstaining, nonabsorbent material, compatible with pointing mortar, joint primers, sealants, and surfaces adjacent to joints; that will easily come off entirely, including adhesive.

F. Miscellaneous Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

   a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
   b. Leave a residue on surfaces.

2.5 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.

2.6 For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

2.7 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick: Dilute with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.

1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.

B. Comply with chemical-cleaner manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical-cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist chemical cleaners used unless chemical cleaners being used will not damage adjacent surfaces. Use materials that contain only waterproof, UV-resistant adhesives. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Keep wall wet below area being cleaned to prevent streaking from runoff.
3. Do not clean masonry during winds of sufficient force to spread cleaning solutions to unprotected surfaces.
4. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.

5. Dispose of runoff from cleaning operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

C. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and projections to protect from mortar droppings.
2. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
3. Immediately remove mortar in contact with exposed masonry and other surfaces.
4. Clean mortar splatters from scaffolding at end of each day.

3.2 UNUSED ANCHOR REMOVAL

A. Remove masonry anchors, brackets, wood nailers, and other extraneous items no longer in use unless identified as historically significant or indicated to remain.

1. Remove items carefully to avoid spalling or cracking masonry.
2. Where directed, if an item cannot be removed without damaging surrounding masonry, do the following:

    a. Cut or grind off item approximately 3/4 inch beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
    b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

3. Patch the hole where each item was removed unless directed to remove and replace the masonry unit.

3.3 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks. Carefully demolish or remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

C. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

D. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

E. Clean bricks surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.

F. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

G. Lay replacement brick with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
1. Rake out mortar used for laying brick before mortar sets and point new mortar joints in repaired area to comply with requirements for repointing existing masonry, and at same time as repointing of surrounding area.
2. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

3.4 CAVITY WALLS – if present at the building exterior walls.

A. Bond wythes of cavity walls together using one of the following methods:

1. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

3.5 CLEANING MASONRY, GENERAL

A. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water will not wash over cleaned, dry surfaces.

B. Use only those cleaning methods indicated for each masonry material and location.

1. Do not use wire brushes or brushes that are not resistant to chemical cleaner being used. Do not use plastic-bristle brushes if natural-fiber brushes will resist chemical cleaner being used.
2. Use spray equipment that provides controlled application at volume and pressure indicated, measured at spray tip. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

a. Equip units with pressure gages.

3. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with cone-shaped spray tip.
4. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.

C. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

D. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces to comply with chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended by manufacturer.

E. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

F. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.6 CLEANING BRICKWORK

A. Acidic Chemical Cleaning:

1. Wet masonry with cold water applied by low-pressure spray.
2. Apply cleaner to masonry in two applications by brush or low-pressure spray. Let cleaner remain on surface for period indicated below:

    a. As recommended by chemical-cleaner manufacturer.
    b. As established by mockup.

3. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use a steam cleaning.

3.7 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:
1. Joints where mortar is missing or where they contain holes.
2. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
3. Cracked joints where cracks are 1/8 inch or more in width and of any depth.
4. Joints where they sound hollow when tapped by metal object.
5. Joints where they are worn back 1/4 inch or more from surface.
6. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
7. Joints where they have been filled with substances other than mortar.
8. Joints indicated as sealant-filled joints.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.

2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, spray applied at low pressure.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Wash adjacent woodwork and other nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

END OF SECTION 04 0120

SECTION 04 2200 - UNIT MASONRY

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. Concrete masonry units. Bullnose units at interior cmu walls “outside“corners.
2. Ground-Face (Burnished) concrete cmu units – 8”h x 16” l x 4”d, typ. at 2’-0” high base at all buildings perimeters.
3. Face brick – new Restroom building to match existing building (Kite Shop) color and texture.
4. Face brick – existing building (Kite Shop) to infill at door opening. Match existing building (Kite Shack) brick in color and texture.
5. Hollow Glass Block units – 8” x 8” x 4” thick nom.size, obscured pattern, final selection via submittal review.
6. Precast stone sill and ledge units – integral color. Color and profile to be selected via submittal review.
7. Mortar with integral color selected via submittal review. Grout for project’s scope masonry work.
8. Steel reinforcing bars.
9. Masonry joint reinforcement.
10. Ties and anchors.
11. Embedded flashing.
12. Miscellaneous masonry accessories.
13. Water repellent application.

B. Related Sections:
1. Section 05 5000 "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
2. Section 04 0120 “Maintenance of Existing Masonry” for repairs , replacement and cleaning of existing brick at Kite Shop building.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. Samples for Initial Selection: Mortar color, when indicated.

D. Samples for Verification: For each type and color of the following:
1. Face brick, in the form of straps of five or more bricks.
2. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep holes.
4. Accessories embedded in masonry.

E. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include data on material properties.
      b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
      c. For exposed brick, include test report for efflorescence according to ASTM C 67.
   2. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   3. Grout mixes. Include description of type and proportions of ingredients.
   4. Reinforcing bars.
   5. Joint reinforcement.
   6. Anchors, ties, and metal accessories.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockups for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
      a. Include a sealant-filled joint at least 16 inches long in each mockup.
      b. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
      c. Include veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
   2. Clean exposed faces of mockups with masonry cleaner as indicated.
   3. Protect accepted mockups from the elements with weather-resistant membrane.
   4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
      a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
      b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.
   1. Density Classification: Normal weight.
   2. Size (Width): As indicated on Drawings. Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.3 GROUND-FACE (BURNISHED) CONCRETE MASONRY UNITS

A. Unit: At building perimeter 2’-0” high base.
   1. ASTM C90, hollow, load-bearing.
   2. Size: 8” x 16” x 4” nom.
   3. Grade: N, 2 -core, typ.

4. Basis -of-Design: Units as manufactured by Consumers Concrete Corp., color to be selected by Architect from manufacturer's standard product colors.
5. Or equivalent approved by Architect prior to bid.

2.4 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following Basis-of-Design products:
a. Base -of Design: Brick A (field) – for bidding purpose use $650/ 1000 units price for brick material. The final selection will be from provided by Architect samples. Belden Brick, product in "mid-red" color range.
2. Grade: SW.
3. Type: FBS, rough.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.
7. Application: Use where brick is exposed unless otherwise indicated.
8. Color and Texture: Match Architect's samples.

2.5 HOLLOW GLASS BLOCK

A. Hollow Glass Block unit made from transparent glass with manufacturer's standard edge coating.

B. Base-of-Design: square-block size:8" nom. x 8"nom. x 3-1/8" thick, wavy, light-diffusive design on inner face, and smooth outer faces. Pattern to be confirmed via submittals review.

C. Provide anchors recommended by glass block manufacturer. Anchors: hot-dip galvanized or stainless steel.

D. Mortar mix: Type S , complying with ASTM C270.

2.6 CAST STONE SILL AND CAP TRIM

A. Provide integral color cast stone components: sills and caps.
1. Comprehensive strength: 6500 psi min. at 28 days , per ASTM C 1194.
2. Absorption: 6% max. at 28 days per ASTM C 1195 or ASTM C 642.
3. Surface texture: fine grained, similar to natural stone. No bug holes or air voids are permitted.

B. Color and Finish: color to be selected from fabricator's standard colors to provide for approximation of Architect's sample.

C. Manufacturers:
1. Terry's Precast Products Inc., (616-396-7042; 4248 Blue Star Hwy., Holland, MI 49423.
2. Continental Cast Stone Manufacturing, Inc.; Shawnee, Kansas 66227; Phone (800) 989-7866; info@continentalcaststone.com .
3. Or approved equivalent by Architect prior to bid.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

D. Masonry Joint Reinforcement for Multi-wythe Masonry:
1. Adjustable (two-piece) type, ladder design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.8 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

B. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.109-inch- thick Hot-Dip galvanized sheet.
3. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.25-inch diameter, Hot-Dip galvanized wire unless otherwise indicated.

C. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

1. Anchor Section: Sheet metal plate, 1-1/4 inches wide by 9 inches long or to suit cavity wall width requirements, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 5-1/2 inches long, stamped into center to provide a slot between strap and plate for inserting wire tie.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: Use the following unless otherwise indicated:
1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
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) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
2) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
3) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
4) Or approved equal.
b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application: Unless otherwise indicated, use the following:
1. Where flashing is partly exposed and is indicated to terminate at wall face, use flexible flashing with a metal drip edge.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

B. Weep/Vent Products: Use the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
a. Products: Subject to compliance with requirements, provide one of the following:
1) Advanced Building Products Inc.; Mortar Maze Cell Vent.
2) Heckmann Building Products, Inc.; No. 85 Cell Vent.
3) Hohmann & Barnard, Inc; QV Quadro-Vent.
4) Or approved equal.

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

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. Archovations, Inc.; CavClear Masonry Mat.
    b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    c. Mortar Net USA, Ltd.; Mortar Net.
    d. Or approved equal.
2. Provide one of the following configurations:
    a. Sheets or strips not less than 1 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
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. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
    b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
    e. Or approved equal.

2.11 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
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. Diedrich Technologies, Inc.
    b. EaCo Chem, Inc.
    c. ProSoCo, Inc.
    d. Or approved equal.

2.12 WATER REPELLENTS

A. Surface Water Repellent treatment shall consist of two(2) coats application of following products:
1. Hydrozo Enviro-Seal Double 7
2. PROSOCO Graffiti Control WB
3. Or approved equal.

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type S.
   3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar for Brick Veneer masonry: Use colored cement product.
   1. Pigments shall not exceed 5 percent of masonry cement by weight.
   2. Selected by Architect from manufacturer's standard colors.

E. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.14 MASONRY LINTELS

A. Provide masonry lintels where openings are shown without structural steel lintels. Provide formed-in-place masonry lintels using special formed U-shaped units with reinforcing bars and filled with type M mortar. Provide minimum 4" bearing for openings less than 6'-0" wide, and 8" for wider.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
   5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in one-third running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Fire-Resistive Joint Systems practices.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   3. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
   1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
      a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
   2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
   1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete masonry backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten to concrete masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed connector sections and continuous wire in masonry joints.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches openings and at intervals, not exceeding 36 inches around perimeter.

B. Provide not less than 1 inch of airspace between back of masonry veneer and face of insulation.
   1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.8 MASONRY-CELL FILL

A. Where indicated on Drawings to install within masonry, pour loose-fill insulation into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Form expansion joints in brick as follows:
   1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

C. Grout all lintels solid.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
4. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install weep vents in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep openings..
2. Space weep holes 24 inches o.c. unless otherwise indicated.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor shall engage special inspectors to perform tests and inspections and prepare reports.

B. Inspections: Level 1 special inspections according to Section 1704 - Special Inspection of the 2012 Michigan Building Code or latest edition.

C. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

D. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

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SECTION 05 500 - METAL FABRICATIONS

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. Metal gate.
   2. Metal guardrails at wall mounted drinking fountain (in Passage area).
   3. Loose steel lintels, furnished but not installed under this Section.

B. Related Sections:
   1. Section 04 2200 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

1.3 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.6 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 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.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

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. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

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.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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.

B. 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.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. 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 so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated on Drawings; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

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.
1. Furnish inserts for units installed after masonry units are placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL GATE

A. General: Comply with ANSI A14.3 unless otherwise indicated.

B. Steel : All rolled shapes - conform to ASTM A36.
1. Cold rolled sheets - conform to ASTM A245.
2. Hot rolled sheets - conform to ASTM A303.
3. Tube Sections - Conform to ASTM A500.
4. Bolts - conform to ASTM A325.

C. Steel Gate:
1. Fabricate gate and anchors as indicated on Drawings.
2. Prime steel gate and associated supporting steel, including brackets and fasteners, with zinc-rich primer.

2.8 LOOSE STEEL LINTELS

A. All lintels, tube columns, and miscellaneous structural steel - conform to ASTM A36.

B. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches unless otherwise indicated.

D. Galvanize loose steel lintels located in exterior walls.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. 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.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

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.

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. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

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.

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

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. Plywood Roof Sheathing.
   2. Plywood Wall Sheathing at gables.
   3. Wood framing, blocking and nailers.

1.3 DEFINITIONS

A. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NLGA: National Lumber Grades Authority.
   2. SPIB: The Southern Pine Inspection Bureau.
   3. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all rough carpentry unless otherwise indicated.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
2. Nailers.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Eastern softwoods; NeLMA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Mixed southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.4 ROOF SHEATHING

A. Plywood Sheathing: DOC PS 1, Exterior grade sheathing.
1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than 5/8 inch.

2.5 WALL SHEATHING

A. Plywood Sheathing: DOC PS 1, Exterior grade sheathing.
   1. Span Rating: Not less than 24/0.
   2. Nominal Thickness: Not less than 1/2 inch.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Bolts: Steel bolts complying with ASTM A 307, Grade A ; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.7 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spun-bonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Do not splice structural members between supports unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in 2012 Michigan Building Code or latest edition.

H. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 PROTECTION

A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 1751 - SHOP- FABRICATED WOOD TRUSSES

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. Wood roof trusses.
      a. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.
      b. Type of trusses configuration: new Restroom building – a regular type, existing building (Kite Shack) to have an attic storage area sized within structural loads limits of the roof trusses configuration.

1.3 SUBMITTALS

A. Product Data: For wood material, metal-plate connectors, metal truss accessories, and fasteners.

B. Shop Drawings: Show fabrication and installation details for trusses.
   1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
   2. Indicate sizes, stress grades, and species of lumber.
   3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
   4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
   5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
   6. Show splicing details and bearing details.

C. Delegated-Design Submittal: For metal-plate-connected wood trusses 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. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

E. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

1.4 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
   1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
   2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
   3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design metal-plate-connected wood trusses per TPI established standards.

B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
   1. Design Loads: As indicated.
   2. Maximum Deflection under Design Loads:
      a. Roof Trusses: Vertical deflection of 1/240 of span.

C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Provide dressed lumber, S4S.
   4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
   2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M Nails, Brads, and Staples: ASTM F 1667.

2.4 METAL FRAMING ANCHORS AND ACCESSORIES

A. Truss Tie-Downs (Hurricane Ties): Bent strap tie for fastening roof trusses to wall studs below, 2-1/2 inches wide by 0.062 inch thick. Tie fits over top of truss and fastens to both sides of truss, inside face of top plates of walls below .

B. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches wide by 0.050 inch thick. Clip is fastened to truss through slotted holes to allow for truss deflection.

C. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

2.5 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
   1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses 24 inches o.c. and as indicated; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

H. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

I. Install wood trusses within installation tolerances in TPI 1.

J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

K. Replace wood trusses that are damaged or do not comply with requirements.

3.2 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces according to ASTM A 780/A 780M and manufacturer's written instructions.

END OF SECTION

SECTION 06 2013 - EXTERIOR FINISH CARPENTRY

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. Exterior and interior wood trim.
   2. T & G cedar wood soffit.
   3. Cedar siding at gable ends, 3” exposure.

B. Related Requirements:
   1. Section 06 1000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.3 SUBMITTALS

A. Product Data: For each type of product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Samples for Initial Selection: T & G soffit material.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Softwood Plywood: DOC PS 1.

2.2 EXTERIOR WOOD TRIM

A. Lumber Trim for Semitransparent-Stained Finish Applications:

1. Species and Grade: Western red cedar, Grade A; NLGA, WCLIB, or WWPA.
2. Maximum Moisture Content: 19 percent.
3. Finger Jointing: Not allowed.
4. Face Surface: smooth.

B. Lumber Trim for Opaque-Stained or Painted Finish:
1. Species and Grade: Western red cedar, Grade A; NLGA, WCLIB, or WWPA.
2. Maximum Moisture Content: 19 percent.
3. Finger Jointing: Not allowed.
4. Face Surfaces: smooth.

2.3 WOOD SOFFIT MATERIAL

A. Soffit material shall be: 1" x 6" T & G boards, Clear, Cedar.

2.4 WOOD SIDING MATERIAL

A. Siding material shall be: Western Red Cedar.
1. Species and Grade: Western Red Cedar, Selected grade or better.
2. Kiln dried: moisture content not to exceed 19 percent.
3. Finger jointing: not allowed.
4. Face surface: smooth.
5. Profile: beveled.
6. Size: 1” x 4”.
7. Finish: opaque-stained or painted finish, see exterior elevations drawings.

B. Provide free air vented areas typical at each gable within the horizontal cedar siding. Include insect screen.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate or as recommended for the specific substrate material.
1. For face-fastening, provide ringed-shank siding nails or hot-dip galvanized-steel trim nails unless otherwise indicated.
2. For cedar, provide hot-dip galvanized-steel fasteners.
3. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
4. For applications not otherwise indicated, provide hot-dip galvanized-steel fasteners.

B. Wood Glue: When required to complete installation, use waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Continuous Soffit Vents: Aluminum hat channel shape with perforations, 2 inches wide and in lengths not less than 96 inches.
1. Net Free Area: 8 sq. in./linear ft. .
2. Finish: Mill or Painted finish.

D. Sealants: Latex, complying with ASTM C 834 and with applicable requirements in Section 07920 "Joint Sealants," recommended by sealant manufacturer and manufacturer of substrates for intended application.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; AC-20+.
b. Tremco, Inc.; Tremflex 834.
c. Or approved equal.

2.6 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches , except members with ends exposed in finished work.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 09911 "Exterior Painting."

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
1. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
2. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
   1. Use scarf joints for end-to-end joints.
   2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

E. Finish: Apply finish within two weeks of installation.

3.5 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean exterior finish carpentry on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

END OF SECTION

SECTION 07 2713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

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 self-adhering, vapor-retarding, modified bituminous sheet air barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
   1. Protect substrates from environmental conditions that affect air-barrier performance.
   2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding 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), when tested according to ASTM E 283.

2.3 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, cross-laminated polyethylene film with release liner on adhesive side.
   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.; CCW-705.
      b. Grace, W. R. & Co. - Conn.; Perm-A-Barrier Wall Membrane.
      c. Meadows, W. R., Inc.; SealTight Air-Shield.
      d. Or approved equal.
   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. Tensile Strength: Minimum 250 psi (1.7 MPa); ASTM D 412, Die C.
      c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
      d. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E 154.
      e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
      f. Vapor Permeance: Maximum 0.05 perm (2.9 ng/Pa x s x sq. m); ASTM E 96/E 96M, Water Method.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Modified Bituminous Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, cross-laminated polyethylene film with release liner backing.

D. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

G. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless-steel fasteners.

H. Modified Bituminous Transition Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

I. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. 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 grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

G. Bridge and cover isolation/expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with overlapping modified bituminous strips.

H. 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.

I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION

A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
   1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. 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.

E. Apply and firmly adhere modified bituminous sheets horizontally 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 without interception by any exposed sheet edges.
   2. Roll sheets firmly to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.
   1. Overlap horizontally adjacent sheets a minimum of 2 inches (50 mm) and roll seams.
   2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
   3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
   4. Continue the membrane into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.

H. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- (150-mm-) wide, modified bituminous strip.

I. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
   1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install modified bituminous strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.

K. Connect and seal exterior wall air-barrier membrane 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.

L. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

M. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

N. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

O. 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.

P. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

END OF SECTION

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SECTION 07 4113 - STANDING-SEAM METAL ROOF PANELS

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. Standing-seam metal roof panels.
   2. Prefinished metal fascia – color to match roof color.
   2. Snow guards typ. at all eaves unless otherwise indicated on roof plan. Color to match roof.

1.3 SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of the flashing, trim, and anchorage systems.

C. Samples for Initial Selection: for each of metal panel factory-applied color finish available.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

E. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

A. Coordinate sizes and locations of roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two (2) years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
   1. Wind Loads: 90 mph or as indicated on Drawings.
   2. Other Design Loads: Snow load 50 psf or as indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:
   1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
   1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 90.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
   1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
   2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels as indicated on Drawings Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.
   1. Basis-of-Design Product: McElroy Metal Inc. , Medallion-Lok Panel, Flat Pan Profile. Initial color selected form deep tone colors: **REGAL BLUE**. Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. MBCI; a division of NCI Group, Inc.
      b. Or approved equal.
   2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      a. Nominal Thickness: 24 gauge. Flat Pan.
      b. Exterior Finish: Two-coat fluoropolymer, Kynar 500 PVDF resin-based.
      c. Color: Patina Green.

3. Clips: One-piece fixed to accommodate thermal movement.
    a. Material: 16 Ga., ASTM A653, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
4. Joint Type: As standard with manufacturer.
5. Panel Coverage: 12 inches.
6. Panel Height: 1.75 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
    1. Thermal Stability: Stable after testing at 240 deg F ; ASTM D 1970.
    2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F ; ASTM D 1970.
    3. Products: Subject to compliance with requirements, provide one of the following:
        a. Carlisle Residential; a division of Carlisle Construction Materials; WIP 300HT.
        b. Grace Construction Products; W.R. Grace & Co. -- Conn.; [Grace Ice and Water Shield HT][Ultra].
        c. Owens Corning; WeatherLock Metal High Temperature Underlayment.
        d. Or approved equal.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Prefinished metal fascia with drip edge: 24 gauge.

B. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

C. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
    1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
    2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
    3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
    4. Ridge vent: Provide manufacturer's standard ridge vent assembly. Finish to match roof panel.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads.

F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
   1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch) thick.
   2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
   3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 SNOW GUARDS

A. Provide one (1) row of seam-mounted snow guard at 12" up from the roof's perimeter edge.

B. Basis-of-Design: ColorGuard as manufactured by S-5! Solutions. (www.S-5!.com). Color strip to match roof panel Kynar PVDF finish. Points of claps attachment to be at every other standing seam (but no more than 24" o.c.). Provide punched ColorGuard crossbar. Snow strips not required.

C. Or approved equal seam-mounted snow guard assembly product.

2.6 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide flat panel profile, including major stiffening ribs, if any required, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.7 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
   1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
   1. Apply over the roof area indicated below:
      a. Roof perimeter for a distance up from eaves of 36 inches beyond interior wall line.
      b. Valleys,from lowest point to highest point, for a distance on each side of 24 inches. Overlap ends of sheets not less than 6 inches .
      c. Rake edges for a distance of 18 inches.
      d. Hips and ridges for a distance on each side of 18 inches.
      e. Around dormers and other penetrating elements for a distance from element of 18 inches.

B. Slip Sheet: Apply slip sheet if required and following metal roofing manufacturer’s recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

B. Fasteners:
   1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of

metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 9200 - JOINT SEALANTS

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. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Latex joint sealants.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants 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.

D. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Field-Adhesion Test Reports: For each sealant application tested.

B. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.6 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 deg F (5 deg 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.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion for weatherseal and non-staining of silicone sealants.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, 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. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
   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 Corning Corporation; 790.
      b. Sika Corporation, Construction Products Division; SikaSil-C990.
      c. Tremco Incorporated; Spectrem 1.
      d. Or approved equal.

B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

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 Corning Corporation; 786 Mildew Resistant.
    b. GE Advanced Materials - Silicones; Sanitary SCS1700.
    c. Tremco Incorporated; Tremsil 200 Sanitary.
    d. Or approved equal.

2.3 URETHANE JOINT SEALANTS

A. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
    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 Building Systems; Sonolastic NP 2.
        b. Pecora Corporation; Dynatred.
        c. Sika Corporation, Construction Products Division; Sikaflex - 2c EZ Mix.
        d. Tremco Incorporated; Vulkem 227.
        e. Or approved equal.

B. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use T.
    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 Building Systems; Sonolastic NP1.
        b. Sika Corporation, Construction Products Division; Sikaflex - 1a.
        c. Tremco Incorporated; Vulkem 116.
        d. Or approved equal.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
    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 Building Systems; Sonolac.
        b. Pecora Corporation; AC-20+.
        c. Tremco Incorporated; Tremflex 834.
        d. Or approved equal.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material 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.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

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 and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.
      c. Porcelain enamel.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

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. 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 sealant backings of kind indicated to support 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 sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below 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 sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
      a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
   2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.
      c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
   4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were

primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess 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.

3.6 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 so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-1.
   1. Joint Locations:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
   2. Urethane Joint Sealant: Single component, nonsag, traffic grade.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-2.
   1. Joint Locations:
      a. Joints between plant-precast architectural concrete units.
      b. Control and expansion joints in unit masonry.
      c. Joints between different materials listed above.
      d. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   2. Urethane Joint Sealant: Multicomponent, nonsag, Class 25.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-3.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Vertical joints on exposed surfaces of concrete.
      d. Isolation joints in cast-in-place concrete slabs.
   2. Urethane Joint Sealant: Single component, nonsag, traffic grade Class 25.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces JS-4.
   1. Joint Locations:
      a. Vertical joints on exposed surfaces of gypsum board.
      b. Perimeter joints between interior gypsum board surfaces and frames of interior doors, and windows.
   2. Joint Sealant: Latex.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces JS-5.
   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

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SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

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 hollow-metal door and frames, and other hollow metal work related to the project.

B. Related Requirements:

1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

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. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Republic Doors and Frames.
4. Steelcraft; an Ingersoll-Rand company.
5. Or approved equal.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Where indicated to be provided, furnish product complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3..

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 2, Seamless.
e. Core: Polystyrene.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. 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.

4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.

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.

2.5 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 ASTM A 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: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

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. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 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. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
2. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
3. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
4. 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.

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. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) high.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    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. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. 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.
3. Provide raceways through doors for cabling, where scheduled for electric/electronic hardware devices.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted hairline joints.

1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
2. Provide loose stops and moldings on inside of hollow-metal work.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.8 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames 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.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. 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.

C. 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).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 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.

END OF SECTION

SECTION 08 7100 - DOOR HARDWARE

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. Door hardware for the following:
      a. Swinging doors at Toilet Rooms – programmable mortise lockset.
      b. Swinging doors for Janitor and Mechanical Room – mortise lockset.
      c. Swinging door for new exterior doors at existing Building (Kite Shack) – mortise lockset.
   2. Door hardware for new doors at existing building (Kite Shop) .
   3. Padlocks and chain specified for metal gates (at new Restroom building). See Section 05 5000 Metal Fabrications.

B. Related Sections:
   1. Section 08 1113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
   1. Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
      a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

C. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

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 follows:
   1. For door hardware, an Architectural Hardware Consultant (AHC) who is also an Electrified Hardware Consultant (EHC).

B. Source Limitations: Obtain each type of door hardware from a single manufacturer.

C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

D. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
   1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

E. Electrified Door Hardware: Where electrified door hardware are required, provide listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.
   1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
   2. Comply with the following maximum opening-force requirements:
      a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
      b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
   3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
   4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.8 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Faulty operation of doors and door hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
   2. Warranty Period: Three (3) years from date of Substantial Completion, unless otherwise indicated.
      a. Exit Devices: Two (2) years from date of Substantial Completion.
      b. Manual Closers: Ten (10) years from date of Substantial Completion.

1.10 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
   1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
   1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
   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. Bommer Industries, Inc. (BOM).
b. McKinney
c. Stanley Commercial Hardware; Div. of The Stanley Works (STA).

2.3 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
3. Deadbolts: Minimum 1-inch (25-mm)bolt throw.

C. 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.
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

D. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
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. Best Access Systems
b. Corbin Russwin
c. Yale Security Inc

2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
4. Manufacturer: Same manufacturer as for locking devices.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.

C. Construction Cores: Provide construction cores that are replaceable by permanent cores.

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. Best Cormax Access Systems.

2.5 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
2. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
3. Keyed Alike: Key all cylinders to same change key.

2.6 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 recommendations 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.

4. 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. Norton Door Controls
   b. Rixson Specialty Door Controls
   c. Yale Security Inc

2.7 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

5. 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. Burns
   b. IVES Hardware; an Ingersoll-Rand company
   c. Rockwood Manufacturing Company

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2.8 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

6. 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. Dorma
   b. Rockwood Manufacturing Company
   c. ABH

2.9 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

7. 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. National Guard Products, Inc.
   b. Pemko Manufacturing Co
   c. Reese Enterprises

2.10 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

8. 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. National Guard Products, Inc.

b. Pemko Manufacturing Co
c. Reese Enterprises, Inc.

2.11 PROGRAMMABLE LOCKS

A. See Hardware Sets schedule for type and manufacturer of programmable locks.

2.12 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

D. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
    a. Wood or Machine Screws: For the following:
        1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
        2) Strike plates to frames.
        3) Closers to doors and frames.
    b. Steel Through Bolts: For the following unless door blocking is provided:
        1) Surface hinges to doors.
        2) Closers to doors and frames.
        3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.
1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

F. 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. Do not install surface-mounted items until finishes have been completed on substrates involved.

G. 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 of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 9200 "Joint Sealants."

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

3.3 ADJUSTING

A. Initial Adjustment: 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.
1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Final Adjustment: Wherever hardware installation is done more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.4 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

J. Clean operating items as necessary to restore proper function and finish.

K. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DOOR HARDWARE SCHEDULE

Set # 1 (Door # 101 102 103 104) – New Restroom building - Family Toilet door (in-swinging)

1 ea	Cont Hinge	662HD	AL	Sta
1 ea	Privacy Push Button	Trilogy DL4100 programmable	626	Tri
1 ea	OH Stop	902S	626	Dor
1 ea	Closer	4040XP	689	LCN
1 ea	Kick plate	10 x 34 x .050	630	Roc
1 ea	Threshold	425 HD	AL	NGP
1 set	Weatherseal	160V 1/36” 2/ 86”	AL	NGP
1 ea	Door Sweep	D608A 36”	CL	NGP

*Programmable Battery Operated Mortise Locksets by Trilogy

Set # 2 (Door # 105) – New Restroom building - Mechanical Room (out swinging door)

1 ea	Cont Hinge	662HD FR	AL	Sta
1 ea	Lockset , Mortise	Storage Function	626	Sta
1 ea	Closer	4040XP	689	LCN
1 ea	Kick plate	10 x 34 x .050	630	Roc
1 ea	Threshold	425 HD	AL	NGP
1 set	Weatherseal	160V 1/36” 2/86”	AL	NGP
1 ea	Door Sweep	D608A 36”	CL	NGP

Set # 3 (Door # 106) – New Restroom building - Janitorial Room (in-swinging door)

1 ea	Cont Hinge	662HD	AL	Sta
1 ea	Lockset, Mortise	Storage Function	626	Sta
1 ea	OH Stop	902S	626	Dor
1 ea	Closer	8916 AF89 FC	689	Dor
1 ea	Kick plate	10 x 34 x .050	630	Roc
1 ea	Threshold	425 HD	AL	NGP
1 set	Weatherseal	160V 1/36” 2/86”	AL	NGP
1 ea	Door Sweep	D608A 36”	CL	NGP

Set # 4 (Door # 107) – Existing building (Kite Shop) - Delivery Door (out- swinging door)

1 ea	Cont Hinge	662HD FR	AL	Sta
1 ea	Lockset , Mortise	Storage Function	626	Sta
1 ea	Closer	4040XP	689	LCN
1 ea	Kick plate	10 x 46 x .050	630	Roc

1 ea	Threshold	425 HD	AL	NGP
1 set	Weatherseal	160V 1/46” 2/86”	AL	NGP
1 ea	Door Sweep	D608A 44”	CL	NGP

Set # 5 (Door # 108) – Existing building (Kite Shack) - Main Door (in-swinging door)

1 ea	Cont Hinge	662HD	AL	Sta
1 ea	Lockset, Mortise	Storage or Entry Function	626	Sta
1 ea	OH Stop	902S	626	Dor
1 ea	Closer	8916 AF89 FC	689	Dor
1 ea	Kick plate	10 x 46 x .050	630	Roc
1 ea	Threshold	425 HD	AL	NGP
1 set	Weatherseal	160V 1/48” 2/86”	AL	NGP
1 ea	Door Sweep	D608A 48”	CL	NGP

Set # 6 (Door # G1 G2)

1 ea	Padlock	Sta

END OF SECTION

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SECTION 09 2900 - GYPSUM BOARD

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. Interior gypsum board ceiling.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

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. Georgia-Pacific Gypsum LLC.
   2. National Gypsum Company.
   3. USG Corporation.
   4. Or approved equal.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

C. High-Impact Type: High-density paperless gypsum and cellulose wall panels.
   1. Complying with ASTM C1278, and C1629.
      a. Basis-of-Design Product: Subject to compliance with requirements, provide "Fiberock VHI" by USG Corporation, or approved equal.
      b. Panel criteria, based upon a 5/8 inch (15.9 mm) thick panel as follows:
         1) Nail-pull resistance: 195 lbf (88 kgf) minimum.
         2) Screw withdrawal: 104 lbf (47 kgf) minimum.
         3) Flexural strength (either direction): 243 lbf (110 kgf) minimum.
         4) Indentation: 0.11 inch (2.79 mm) maximum, based upon ASTM D5420.
         5) Hard-body impact: 80 ft-lbs (114 N-m) minimum.
         6) Soft-body impact – structural failure: 210 ft-lbs (284 N-m) minimum, based upon ASTM E695.
         7) Soft-body impact: 200 impacts minimum, based upon ASTM E695 – Modified.
   2. Core: 5/8 inch (15.9 mm) thick.
   3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
   2. Shapes:
      a. Cornerbead.
      b. L-Bead: L-shaped; exposed long flange receives joint compound.
      c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
   3. Tile Backing Panels: As recommended by panel manufacturer.

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 setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping for vertical applications, and drying-type, all-purpose compound for ceilings.
4. Finish Coat: For third coat, use setting-type, sandable topping for vertical applications, and drying-type, all-purpose compound for ceilings.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. 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 tile backer units, use screws of type and size recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Form control and expansion joints with space between edges of adjoining gypsum panels.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
1. Type X, Impact-Resistant Type: Toilet rooms ceilings applications only.
2. Type X: existing building (Kite Shop) ceilings applications only.

B. Single-Layer Application:

1. Stagger abutting end joints not less than one framing member in alternate courses of panels.

C. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: 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.

B. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners.
2. L-Bead: Use where indicated.

3.5 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 6723 – RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. High-performance resinous flooring systems.
   2. 4” high integral Cove Base – using system to form the integral base as recommended by resinous flooring manufacturer.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Installer Certificates for Qualification: Signed by manufacturer stating that installers comply with specified requirements.
C. Material Certificates: For each resinous flooring component, from manufacturer.
D. Maintenance Data: For maintenance manuals.
E. Samples: Submit two 6” X 6” samples of each resinous flooring system applied to a rigid backing. Provide sample which is a true representation of proposed field applied finish. Provide sample color and texture for approval from Owner in writing or approved by General Contractor prior to installation.
F. Product Schedule: For resinous flooring.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
   1. Engage an installer who is approved in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
   2. Installer Letter of Qualification: Installer to provide letter stating that they have been in business for at least 5 years and listing 5 projects in the last 2 years of similar scope. For each project provide: project name, location, date of installation, contact information, size of project, and manufacturer of materials with system information.
B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
C. Pre-installation Conference: Conduct conference at Project site before work and mockups begin.
D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Do not cover up mockup area.
   1. Apply full-thickness mockups on 16 square foot floor area selected by Architect.
   2. Finish surfaces for verification of products, color, texture, and sheen.
   3. Simulate finished lighting conditions for Architect's review of mockups.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
   5. Mockup shall demonstrate desired slip resistance for review and approval by Owner’s representative in writing.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by:
1. The Sherwin Williams Company, Cleveland, OH. Representative Contact: Kyle Workman (616-293-0415) kyle.r.workman@sherwin.com or Michael Starner (484) 624-2360 michael.starner@sherwin.com .

B. Resuflor Deco Flake BC, 20-30 mils nominal thickness.
1. Primer: Resuprime 3579 at 200-300 sq. ft. per gallon.
2. Body Coat: Resuflor 3746 at 200-300 sq. ft. per gallon.
3. Broadcast: Decorative Flakes 6750 or 6755 to excess at 100-200 lbs. per 1,000 sq. ft.
4. Grout Coat: Resuflor 3746 at 160-250 sq. ft. per gallon.
5. Seal Coat: Resutile 4686 at 250-400 sq. ft. per gallon.

2.2 MATERIALS

A. VOC Content of Resinous Flooring: Provide resinous flooring systems, for use inside the weatherproofing system, that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
1. Resinous Flooring: 100 g/L.

2.3 HIGH-PERFORMANCE RESINOUS FLOORING

A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, high-performance, resin-based, monolithic floor surfacing designed to produce a seamless floor.
B. System Characteristics:
1. Color and Pattern**: Initial selection – "PYRITE" , 1/8" flake size.** As indicated from manufacturer listed above.
2. Slip Resistance: Provide slip resistant finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspection: Prior to commencing Work, thoroughly examine all underlying and adjoining work, surfaces and conditions upon which Work is in any way dependent for perfect results. Report all conditions which affect Work. No "waiver of responsibility" for incomplete, inadequate or defective underlaying and adjoining work, surfaces and conditions will be considered, unless notice of such unsatisfactory conditions has been filed and agreed to in writing before Work begins. Commencement of Work constitutes acceptance of surfaces.
B. Surface Preparation: Remove all surface contamination, loose or weakly adherent particles, laitance, grease, oil, curing compounds, paint, dust and debris by blast track method or

approved mechanical means (acid etch not allowed). If surface is questionable try a test patch. Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile numbers as follows:

C.

1. Thin film, to 10 mils CSP-1 to CSP-3
2. Thin and medium films, 10 to 40 mils CSP-3 to CSP-5
3. Self-leveling mortars, to 3/16” CSP-4 to CSP-6
4. Mortars and laminates, to 1/4” or more CSP-5 to CSP-10

D. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
   1. Moisture Testing: Perform tests indicated below.
      a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours. Perform tests so that each test area does not exceed 1000 sq. ft. and perform 3 tests for the first 1000 sq. ft. and one additional test for every additional 1000 sq ft.
      b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.

3.2 ENVIRONMENTAL CONDITIONS

A. All applicators and all other personnel in the area of the RF installation shall take all required and necessary safety precautions. All manufacturers’ installation instructions shall be implicitly instructions shall be implicitly followed.
B. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
C. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
E. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
F. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.3 APPLICATIONS

A. Install resinous floor over properly prepared concrete surface in strict accordance with the manufacturer's directions.
   1. Install the primer and/or base coats over thoroughly cleaned and prepared concrete.
   2. Install topcoat over flooring after excess aggregate has been removed.
   3. Maintain a slab temperature of 60°F to 80°F for 24 hours minimum before applying floor topping, or as instructed by manufacturer.
B. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
   1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
   2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
   3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
C. Sealant: Saw cut resinous floor topping at expansion joints in concrete slab. Fill sawcuts with sealant prior to final seal coat application. Follow manufacturer’s written recommendations.
D. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

E. Slip Resistant Finish: Provide grit for slip resistance.
F. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.4 COMPLETED WORK

A. Cleaning: Upon completion of the Work, clean up and remove from the premises surplus materials, tools, appliances, empty cans, cartons and rubbish resulting from the Work. Clean off all spattering and drippings, and all resulting stains.
B. Protection: Protect Work in accordance with manufacturer's directions from damage and wear during the remainder of the construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.
C. Contractor shall insure that coating is protected from any traffic until it is fully cured to the satisfaction of the coating manufacturer.

END OF SECTION

SECTION 09 9113 – EXTERIOR PAINTING

PART 1 - GENERAL

1.01 NOTICE:

The General Conditions, Supplementary General Conditions and Special Conditions are part of this section.

1.02 DESCRIPTION OF WORK:

A. Extent of painting work is shown on drawings and schedules, and as herein specified:
1. Hollow metal doors and frames.
2. Metal gates and guardrail.
3. T & G cedar soffit, solid or semi-transparent stain.
4. Cedar wood running trim, solid or semi-transparent stain.
5. Cedars siding at roof gables, solid or semi-transparent stain.

B. The work includes painting and finishing of exterior items and surfaces throughout project, except as otherwise indicated.

C. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.

D. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

E. Paint exposed surfaces whether or not colors are designated in "schedules", except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint same as adjacent similar materials or areas. If color or finish is not designated, Architect will select these from standard colors available for materials systems specified.

F. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, furred areas, pipe spaces and duct shafts.

G. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.

H. Operating Parts and Labels: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.

I. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

1.03 DELIVERY AND STORAGE:

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information.

- Name of material
- Manufacturer's stock number and date of manufacture

- Manufacturer's name
- Contents by volume, for major pigment and vehicle constituents
- Thinning instructions
- Application instructions
- Color name and number
- Manufacturer’s safety data sheets

1.04 JOB CONDITIONS:

A. Apply paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50° F and 90° F, unless otherwise permitted by paint manufacturer's printed instruction.

B. Do not apply paint in snow, rain, fog or mist; or when relative humidity exceeds 85%; or on damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

Sherwin-Williams, Pittsburgh, DeVoe, B.F. Moore, DuPont, or Glidden.

2.02 COLORS AND FINISHES:

A. Prior to beginning work, Architect will furnish color chips for surfaces to be painted. See included schedule and invoice for Owner’s standard colors. Verify <u>all</u> color selections with Architect prior to ordering paint.

B. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.03 MATERIAL QUALITY:
Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturer. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

2.04 EXTERIOR PAINT SYSTEMS:

A. <u>Ferrous Metal</u>:

1st Coat Zinc Chromate Primer
2nd Coat Enamel Under-coater
3rd Coat Semi-Gloss Enamel, brush applied

B. <u>Galvanized Steel</u>:

1st Coat Zinc dust
2nd Coat Exterior Enamel
3rd Coat Semi-Gloss Enamel, brush applied

C. Wood siding, soffit and trim Stain:

1st Coat	Primer Coat (per Stain manufacturer recommendation)
2nd Coat	Semi-Transparent or solid acrylic stain
3rd Coat	Semi-Transparent or solid acrylic stain

PART 3 - EXECUTION

3.01 INSPECTION:

A. Applicator must examine areas and conditions under which painting work is to be applied and notify General Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.02 SURFACE PREPARATION:

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Following completion of painting of each space or area, reinstall removed items.

C. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

D. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

E. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

F. Wood: Clean wood surfaces to be painted of dirt, oil or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of primer coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dry.

Prime and stain or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, undersides, and backsides of such wood, including cabinets, counters, cases, paneling.

3.03 MATERIALS PREPARATION:

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

3.04 APPLICATION:

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

C. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment of furniture with prime coat only before final installation of equipment.

D. Paint backsides of access panels, and removable or hinged covers to match exposed surfaces.

E. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.

F. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

G. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

H. Allow sufficient time between successive coatings to permit proper drying. Do not re-coat until paint has dried to where it feel firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

I. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

3.05 CLEANUP AND PROTECTION:

A. Cleanup: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each workday.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

C. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protections of their work, after completion of painting operations.

D. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS (interior)

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 surface preparation and application of high-performance coating systems on the following substrates:
   1. Interior Substrates:
      a. Concrete masonry units (CMU).
      b. Gypsum board.
      c. Wood trim.

B. Related Requirements:
   1. Section 09 9113 "Exterior Painting" for general exterior field painting.

1.3 DEFINITIONS

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
   3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The).
4. Or approved equal.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."

B. Material Compatibility:
1. Provide materials for use within each coating system that are 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 coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
1. Nonflat Paints and Coatings: 150 g/L.
2. Primers, Sealers, and Undercoaters: 200 g/L.

D. Colors: Initial selection as indicated in a color schedule.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.
1. Benjamin Moore & Co.; Super Spec, High Build Interior/Exterior Block Filler, 206/K206.
2. PPG Architectural Finishes, Inc.; Pittsburgh Paints, Speedhide Int/Ext Acrylic Masonry Block Filler, 6-15.

3. Sherwin-Williams Company (The); PrepRite, Int/Ext Block Filler, B25W25.

2.4 INTERIOR PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.
1. Benjamin Moore & Co.; Ben, Premium Interior Latex Primer, W624/K624.
2. PPG Architectural Finishes, Inc.; Speedhide, Interior Latex Sealer Quick-Drying, 6-2.
3. Sherwin-Williams Company (The); ProGreen 200, Interior Latex Primer, B28W00600/B28WQ860.

2.5 EPOXY COATINGS

A. Epoxy-Modified Latex, Interior Gloss (Gloss Level 6): MPI #115.
1. Benjamin Moore & Co.; Super Spec HP, Waterborne Polyamide Epoxy, P42.
2. PPG Architectural Finishes, Inc.; Aquapon WB, Aquapon WB Water Base Epoxy, 98.
3. Sherwin-Williams Company (The); Pro Industrial Zero VOC Waterborne Catalyzed Epoxy Gloss, B73W00311.

2.6 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

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.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
a. Concrete CMU: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Gypsum Board: 12 percent.
d. Wood Trim: 15 percent.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

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.
1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates 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.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
   1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

E. Interior Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
   3. Sand surfaces exposed to view and dust off.

F. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for coating and substrate indicated.
   2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

B. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:
   1. Epoxy System:
      a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
      b. Intermediate Coat: Epoxy, gloss, MPI #115.
      c. Topcoat: Epoxy, gloss, MPI #115.

B. Gypsum Board Substrates:
   1. Epoxy System:
      a. Prime Coat: Primer sealer, latex, interior, MPI #50.
      b. Intermediate Coat: Epoxy, gloss, MPI #115.
      c. Topcoat: Epoxy, gloss, MPI #115.

3.6 INTERIOR STAIN SCHEDULE (WOOD TRIM)

A. Wood Trim Substrates:
   1. Solid Stain System:
      a. Prime Coat: Primer, alkyd for interior wood, MPI #5.
      b. Intermediate Coat: Stain, interior water based, solid hide, matching topcoat
      c. Topcoat: Stain, interior, water based, solid hide, MPI #16.

3.7 HIGH-PERFORMANCE COATING COLOR SCHEDULE

A. Basis-of-Design Colors: Provide the following, or approved equal:
   1. P1: Sherwin Williams Company (The); SW 6077 “Every Day White”.
      a. Primary CMU wall color. Initial selection to be confirmed via submittals review.
   2. P2: Sherwin Williams Company (The); SW 6105 ”Divine White”.
      a. Primary gypsum board ceiling color. Initial selection to be confirmed via submittals review.
      b. Primary plywood ceiling color. Initial selection to be confirmed via submittals review

3.8 INTERIOR STAIN (WOOD TRIM) SCHEDULE

A. Basis-of-Design Stain Color: provide the following, or approved equal:
   1: S1: Sherwin Williams Company (The); SW 3002 Belvedere Tan.
      a. Primary wood trim stain color. Initial selection to be confirmed via submittals review.

END OF SECTION 09 9600

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SECTION 10 1423 – ROOM IDENTIFICATION SIGNAGE

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. Barrier- Free Accessibility signage for the Family Toilet Rooms (total of 4).

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.
   1. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size. Show attachment method information.

C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Barrier- Free Accessibility signage for Family Toilets: Full-size Sample.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for signs.

2.2 SIGNS

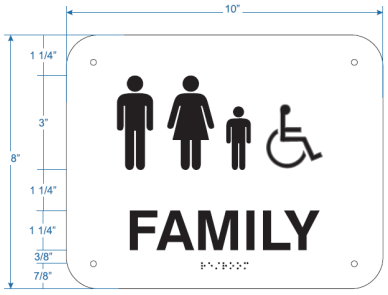
A. Manufacturer: Subject to compliance with requirements, provide die-raised aluminum signage, as manufactured by one of the following:
   1. The Supersine Company
   2. A.R.K. Ramos
   3. Or approved equal.
   4. Basis-of-Design Product: Signs to be made of die-raised aluminum with baked enamel finish.
   5. Sign panel: smooth finish with raised pictogram barrier-free symbol and name designation of : FAMILY in 1 1/2" high Helvetica type and Grade 2 Braille.
      a. Color(s): Black background , Aluminum copy.

b. Sign-Panel Perimeter: Finish edges smooth, Square cut.

6. Mounting: Surface mounted with anchorage into a face brick veneer.

7. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range, and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

B. Example of pictorial:



PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1423

SECTION 10 8000 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 NOTICE:

The General Conditions, Supplementary General Conditions and Special Conditions are part of this section.

1.2 DESCRIPTION OF WORK:

A. The work in this section consists of furnishing all labor, material and equipment to execute toilet accessory work for this project.

1.3 SUBMITTAL:

A. Submit catalog cuts on all items.

B. Deliver materials to project site in original sealed containers bearing manufacturer's labels.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. McKinney, Bobrick, Bradley Co., American Specialties, or equal, as approved by Architect prior to bid.

Part numbers listed below are those of Bobrick Washroom Equipment, Inc.

2.2 SCHEDULE:

A. Grab bars: Horizontal and vertical grab bars with concealed mounting, 18-gauge, type-304 stainless steel, Peened, non-slip gripping surface with satin finish flange and end of bar.

B. Toilet Tissue Dispenser: By Owner . Installed by GC.

C. Sanitary Napkin Disposal: Bobrick B-270, 22-gauge, type 304 stainless steel, satin finish.

D. Coat Hook: Bobrick B-212, coat hook with bumper.

E. Hand Soap Dispenser: By Owner. Installed by GC.

F. Mirror: Bobrick B-165 1836, one-piece channel frame with bright polished finish and mitered corners.

G. Hand Dryer: NO EXCEPTIONS TAKEN; manufactured by Excell - ThinAir , Model TA-W ; surface mounted, no-touch control, cast body + white epoxy painted cover.

H. Backsplash Panels at Hand Dryers: each panel to be 15” wide x 56” high, solid surfacing wall mounted panel. Color selected from solid surfacing material manufacturer’s standard selection; initial selection based on Corian – price group C. Include all trim required for a complete installation directly at cmu wall / behind each dryer unit.

I. Baby Changing Station: Koala Kare; KB200-SS Koala, horizontal, stainless steel. Color: Grey (01).

J. Barrier-Free Signage: See Section 10 1423 “ Room Identification Signage” for Family Toilet Room signage to be installed at entry side of toilet room door.

K. Or approved equal, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install items in accordance with manufacturer's instructions.

Locate items as indicated on drawings, or if not indicated as directed by Architect.

END OF SECTION 10 8000

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT SECTION 22 0529

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Welding certificates.

1.3 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig, ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick 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.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. 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.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. 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.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

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 allowed by 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.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

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.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

F. Use padded hangers for piping that is subject to scratching.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. 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 up to 1050 deg F, pipes NPS 4 to NPS 24, 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 36, 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 or carbon-steel plate.
7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

9. 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.

I. 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 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. 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.

K. 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.

L. 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.

M. 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 allow expansion and contraction of piping system from base support.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 0529

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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, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 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.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
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, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
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: Red.

C. Background Color: White.

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, semi rigid 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.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

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.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:

    a. Background Color: Black.
    b. Letter Color: Yellow.

2. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Black.
    b. Letter Color: White.

END OF SECTION 220553

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
   c. Polyolefin.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
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 attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Field quality-control reports.

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.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 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. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. 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, provide one of the following:

a. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.

H. 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, provide one of 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.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fibrex Insulations Inc.; Coreplus 1200.
    b. Johns Manville; Micro-Lok.
    c. Knauf Insulation; 1000 Pipe Insulation.
    d. Manson Insulation Inc.; Alley-K.
    e. Owens Corning; Fiberglas 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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ 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, provide one of 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.

K. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Armacell LLC; Tubolit.
    b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
    c. RBX Corporation; Therma-cell.

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, provide one of the following:

    a. Insulco, Division of MFS, Inc.; SmoothKote.
    b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA Inc.; Aeroseal.
    b. Armacell LCC; 520 Adhesive.
    c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

2. 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).

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Products, Division of ITW; CP-82.
    b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    d. Marathon Industries, Inc.; 225.
    e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); 739, Dow Silicone.
    b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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, provide one of 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.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of 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.
d. Marathon Industries, Inc.; 550.
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.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-70.
b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
c. Marathon Industries, Inc.; 405.

d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.
7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of 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.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of 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.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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, provide one of 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, provide one of the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

a. Products: Subject to compliance with requirements, provide one of 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, provide one of the following:

a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
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, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
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, provide one of the following:

    a. Childers Products, Division of ITW; Metal Jacketing Systems.
    b. PABCO Metals Corporation; Surefit.
    c. RPR Products, Inc.; Insul-Mate.

2. Sheet and roll stock ready for shop or field sizing.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
6. 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, provide one of the following:

    a. Pittsburgh Corning Corporation; Pittwrap.
    b. Polyguard; Insulrap No Torch 125.

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, provide one of 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.
4. Adhesion: 90 ounces force/inch in width.
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, provide one of 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.
4. Adhesion: 90 ounces force/inch in width.
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, provide one of 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.
4. Adhesion: 64 ounces force/inch in width.
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, provide one of 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.
4. Adhesion: 100 ounces force/inch in width.
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, provide one of 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, 1/2 inch wide with wing or closed seal.

1. Products: Subject to compliance with requirements, provide one of 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, provide one of 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, provide one of 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, provide one of 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, provide one of 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, provide one of 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
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 2 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.
4. Manholes.
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.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

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 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 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.

3.7 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install 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 cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 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.

3.9 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.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

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.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. 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 three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 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.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot, Hot and Recirculated Hot Water: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1 inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1 inch thick.

3.13 INDOOR, 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. Piping, Concealed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Smooth: 0.016 inch thick.

D. Piping, Exposed:

1. None.
2. PVC: 20 mils thick.
3. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION 22 0700

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Copper Pressure-Seal-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elkhart Products Corporation; Industrial Division.

2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

6. Copper Push-on-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) NVent LLC.

b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Copper Pressure-Seal-Joint Fittings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Elkhart Products Corporation; Industrial Division.
2) NIBCO INC.
3) Viega; Plumbing and Heating Systems.

b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PVC PIPE AND FITTINGS

A. PVC Pipe: ASTM D 1785, Schedule 40 and Schedule 80.

1. PVC Socket Fittings: ASTM D 2466 for Schedule 40 and ASTM D 2467 for Schedule 80.

2.4 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, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 SPECIALTY VALVES

A. PVC Union Ball Valves:

1. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 125 psig at 73 deg F.
c. Body Material: PVC.
d. Body Design: Union type.
e. End Connections for Valves NPS 2 and Smaller: Detachable, socket.
f. Ball: PVC; full port.
g. Seals: PTFE or EPDM-rubber O-rings.
h. Handle: Tee shaped.

B. PVC Gate Valves:

1. Description:

a. Pressure Rating: 125 psig at 73 deg F.
b. Body Material: PVC.
c. Body Design: Nonrising stem.
d. End Connections for Valves NPS 2 and Smaller: Socket.
e. Gate and Stem: Plastic.
f. Seals: EPDM rubber.
g. Handle: Wheel.

2.6 TRANSITION FITTINGS

A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

B. Sleeve-Type Transition Coupling: AWWA C219.

C. Plastic-to-Metal Transition Fittings:

1. Description: CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

1. Description: CPVC or PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:

a. Pressure Rating: 150 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Description:

a. Galvanized-steel coupling.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves.

G. Install domestic water piping level without pitch and plumb.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. 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.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping adjacent to equipment and specialties to allow service and maintenance.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install PEX piping with loop at each change of direction of more than 90 degrees.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump.

S. Install thermostats in hot-water circulation piping.

T. Install thermometers on inlet and outlet piping from each water heater.

U. Install sleeves for piping penetrations of walls, ceilings, and floors.

V. Install sleeve seals for piping penetrations of concrete walls and slabs.

W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. 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.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

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. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Piping: Join according to ASTM D 2855.

J. PEX Piping Joints: Join according to ASTM F 1807.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

B. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

C. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

3.6 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.

I. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

J. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

K. Install hangers for vertical PEX piping every 48 inches.

L. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 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.

M. Install supports for vertical PVC piping every 48 inches.

N. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water, building service piping, NPS 3 and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; copper pressure-seal fittings; and pressure-sealed joints.

D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L; copper push-on-joint fittings; and push-on joints.
4. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints.
5. PEX Tube, NPS 1 and smaller; fittings for PEX tube; and crimped joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

D. CPVC and PVC valves matching piping materials may be used.

END OF SECTION 221116

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Stant.
g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Dallas Specialty & Mfg. Co.
2) Fernco Inc.
3) Mission Rubber Company; a division of MCP Industries, Inc.
4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. 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.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage 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.

J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 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 Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. 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."

L. Install aboveground PVC piping according to ASTM D 2665.

M. Install underground PVC piping according to ASTM D 2321.

N. Plumbing Specialties:

1. Install backwater valves in sanitary waste gravity-flow piping.
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping.
3. Install drains in sanitary drainage gravity-flow piping.

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

E. Plastic, Nonpressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

3.4 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.
5. Install individual, straight, horizontal piping runs:

    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.

6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. 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 and NPS 8: 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.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.

J. Install supports for vertical PVC piping every 48 inches.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. 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.

3.7 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 and before setting fixtures.
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 sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

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.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; cast-iron hubless-piping couplings; and coupled joints.
3. PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 1316

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, 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. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. Oatey.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, 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. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
5. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Commercial Enameling Co.
b. Josam Company; Josam Div.
c. MIFAB, Inc.
d. Prier Products, Inc.
e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
f. Tyler Pipe; Wade Div.
g. Watts Drainage Products Inc.
h. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.

9. Top or Strainer Material: Nickel bronze.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

   a. NPS 2: 4-inch-minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

G. Assemble open drain fittings and install with top of hub 1 inch above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Grease Interceptors: Connect inlet and outlet to unit and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

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.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.5 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 221319

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Residential, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated.

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

C. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Operation and maintenance data.

H. Warranty: Sample of special warranty.

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. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.

a. Residential, Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: 10 years.
2) Controls and Other Components: Two years.

b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 RESIDENTIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Residential, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bradford White Corporation.
b. Lochinvar Corporation.
c. Rheem Manufacturing Company.
d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.

2. Standard: UL 174.
3. Storage-Tank Construction: Steel.

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 150 psig (1035 kPa).
c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.
b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
c. Drain Valve: ASSE 1005.
d. Insulation: Comply with ASHRAE 90.2.
e. Jacket: Steel, cylindrical, with enameled finish.
f. Heat-Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.
g. Heating Elements: Two; electric, screw-in immersion type; wired for nonsimultaneous operation unless otherwise indicated. Limited to 12 kW total.
h. Temperature Control: Adjustable thermostat.
i. Safety Control: High-temperature-limit cutoff device or system.
j. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

   a. AMTROL Inc.
   b. Flexcon Industries.
   c. Honeywell International Inc.
   d. Pentair Pump Group (The); Myers.
   e. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
   f. State Industries.
   g. Taco, Inc.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- (172.5-kPa-) maximum outlet pressure unless otherwise indicated.

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches (457 mm) above the floor.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Residential, Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on floor.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 22 Section "Domestic Water Piping Specialties."

E. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Division 22 Section "Domestic Water Piping Specialties."

F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

G. Fill electric, domestic-water heaters with water.

H. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

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.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

END OF SECTION 22 3300

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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Faucets for lavatories and sinks.
2. Toilet seats.
3. Protective shielding guards.
4. Fixture supports.
5. Water closets.
6. Lavatories.
7. Service sinks

1.2 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. FRP: Fiberglass-reinforced plastic.

D. PMMA: Polymethyl methacrylate (acrylic) plastic.

E. PVC: Polyvinyl chloride plastic.

F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and maintenance data.

1.4 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Plastic Shower Enclosures: ANSI Z124.2.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Slip-Resistant Bathing Surfaces: ASTM F 462.
4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
5. Stainless-Steel Residential Sinks: ASME A112.19.3.
6. Vitreous-China Fixtures: ASME A112.19.2M.
7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Grab Bars: ASTM F 446.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Hot-Water Dispensers: ASSE 1023 and UL 499.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.

9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Bradley Corporation.
c. Chicago Faucets.
d. Delta Faucet Company.
e. Eljer.
f. Elkay Manufacturing Co.
g. Just Manufacturing Company.
h. Kohler Co.
i. Moen, Inc.
j. Royal Brass Mfg. Co.
k. Speakman Company.
l. T & S Brass and Bronze Works, Inc.
m. Zurn Plumbing Products Group; Commercial Brass Operation.

2.2 SINK FAUCETS

A. Sink Faucets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Bradley Corporation.
c. Chicago Faucets.
d. Delta Faucet Company.
e. Dormont Manufacturing Company.
f. Eljer.
g. Elkay Manufacturing Co.
h. Just Manufacturing Company.
i. Kohler Co.
j. Moen, Inc.
k. Speakman Company.
l. T & S Brass and Bronze Works, Inc.
m. Zurn Plumbing Products Group; Commercial Brass Operation.

2.3 TOILET SEATS

A. Toilet Seats:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.

b. Bemis Manufacturing Company.
c. Centoco Manufacturing Corp.
d. Church Seats.
e. Eljer.
f. Kohler Co.
g. Olsonite Corp.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Engineered Brass Co.
b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
c. McGuire Manufacturing Co., Inc.
d. Plumberex Specialty Products Inc.
e. TCI Products.
f. TRUEBRO, Inc.
g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2.5 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

2.6 WATER CLOSETS

A. Water Closets:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Eljer.
c. Gerber Plumbing Fixtures LLC.
d. Kohler Co.
e. Peerless Pottery, Inc.
f. TOTO USA, Inc.

2.7 LAVATORIES

A. Lavatories:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Commercial Enameling Company.
c. Eljer.
d. Kohler Co.

2.8 SERVICE SINKS

A. Service Sink:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.
b. Eljer.
c. Kohler Co.
d. Crane Plumbing, L.L.C./Fiat Products.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

K. Install toilet seats on water closets.

L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install shower flow-control fittings with specified maximum flow rates in shower arms.

P. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

Q. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

R. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install in sink deck. Connect inlet hose to dishwasher and outlet hose to disposer.

S. Install hot-water dispensers in back top surface of sink or in countertop with spout over sink.

T. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

U. Set bathtubs and showers in leveling bed of cement grout.

V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. EZ Wall Mounted Drinking Fountain

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants" for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

    a. Most Dependable Fountains

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings. See below:

    a. Most Dependable Fountains

2.2 FIXTURE SUPPORTS

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    1. Most Dependable Fountains.

C. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

    1. Type I: Hanger-type carrier with two vertical uprights.
    2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
    3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Set freestanding and pedestal drinking fountains on floor.

C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.5 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

END OF SECTION 22 4700

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. 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"**.**

C. 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.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. 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, provide products by one of the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.
f. Universal Spiral Air

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 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.
3. Shore A Hardness: Minimum 20.
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.

2.5 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:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
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. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

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 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 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."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.

12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 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.

3.6 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.

3.7 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.

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.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
c. Welded seams and joints.
d. Pressure Class: Positive or negative 2-inch wg.
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

4. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 without vanes.

b. Velocity:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: [Standing seam] [Welded].

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 23 3113

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Ceiling-mounting ventilators.
2. In-line centrifugal fans.

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 CEILING-MOUNTING VENTILATORS

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. American Coolair Corp.
2. Ammerman; General Resource Corp.

3. Breidert Air Products.
4. Broan Mfg. Co., Inc.
5. Carnes Company HVAC.
6. Dayton Electric Manufacturing Co.; a division of W. W. Grainger, Inc.
7. FloAire.
8. Greenheck.
9. JencoFan; Div. of Breidert Air Products.
10. Loren Cook Company.
11. NuTone Inc.
12. Penn Ventilation.

D. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

E. Housing: Steel, lined with acoustical insulation.

F. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

G. Grille: Stainless steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

I. Accessories:

1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
3. Motion Sensor: Motion detector with adjustable shutoff timer.
4. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
5. Filter: Washable aluminum to fit between fan and grille.
6. Isolation: Rubber-in-shear vibration isolators.
7. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.2 IN-LINE CENTRIFUGAL FANS

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Acme Engineering & Mfg. Corp.
2. American Coolair Corp.
3. Ammerman; General Resource Corp.
4. Bayley Fans; a division of Lau Industries, Inc.
5. Breidert Air Products.
6. Carnes Company HVAC.
7. FloAire.
8. Greenheck.

9. Hartzell Fan, Inc.
10. JencoFan; Div. of Breidert Air Products.
11. Loren Cook Company.
12. Madison Manufacturing.
13. Penn Ventilation.

D. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

E. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

F. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

G. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

H. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

I. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

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. Support units using elastomeric mounts having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

I. 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."

J. Install ducts adjacent to power ventilators to allow service and maintenance.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

L. 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 233423

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fixed face 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.

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.

PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carnes.
b. Hart & Cooley Inc.
c. Krueger.
d. Nailor Industries Inc.
e. Price Industries.
f. Titus.
g. 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 3713

PART 1 GENERAL

1.01 RELATED SECTIONS

A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements (if any), apply to the work specified in this Section.

1.02 DESCRIPTION OF WORK

A. This Section specifies several categories of provisions for electrical work, including:
   1. Certain adaptive expansions of requirements specified in Division 1.
   2. General performance requirements within the electrical systems as a whole.
   3. General work to be performed as electrical work because of its close association.
   4. Drawings and Specifications:
      a. Drawings: Refer to the E-Series Drawings for graphic representations, schedules, and notations showing electrical work.
      b. Specifications: Refer to the bid categories for the related primary technical specifications of electrical work.
      c. Drawings and Specifications are intended to supplement each other, and all work specified or indicated in either shall be provided.

1.03 COORDINATION OF ELECTRICAL WORK

A. General: Refer to the Division 1 sections for general coordination requirements applicable to the entire scope of work. It is recognized that the documents are diagrammatic in showing physical relationships which must be established within the electrical work, and in its interface with other work, including utilities and mechanical work. Such establishment is the exclusive responsibility of the Electrical Contractor.

B. Advise other trades of openings required in their work for the installation of large electrical equipment.

C. The Electrical Contractor shall be responsible for all subcontractors and suppliers, and include in his bid all materials, labor, and equipment to other trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, and decisions and secure compliance of all parts of the specifications and drawings regardless of Sectional inclusion in these specifications.

D. Equipment Clearance:
   1. Electrical Contractor to coordinate with the Mechanical Contractor's equipment locations, to insure adequate clearance is maintained, as required by the National Electrical Code, applicable state and local codes, and for future maintenance and operation.

E. Wall, Floor and Ceiling Openings:
   1. E.C. is responsible for preventing water from entering through any exterior wall or floor penetrations via conduits or cracks and/or rough edges of openings made.

1.04 PRODUCT SUBSTITUTIONS

A. Substitutions requested for review during or after bidding may be reviewed by the WPF Engineering upon request at a fee of $500.00 per product review. Substitutions for actual fixtures, lamps and poles will not be accepted.

1.05 SUBMITTAL PROCEDURES

A. General: Refer to Division 1 for general administrative/procedural requirements related to shop drawings. Provide Shop drawings for all equipment as specified in individual specification sections. Provide at a minimum 6 copies of each shop drawing.

1.06 SITE AND PROJECT DOCUMENTATION EXAMINATION

A. Submission of proposal is considered evidence the Electrical Contractor has visited site, examined drawings and specifications of all trades including Architectural, Structural, Mechanical and Electrical, and fully informed himself with all project and site conditions. It is also evidence that they are proficient, experienced, and knowledgeable of all standards, codes, ordinances, permits, and regulations which affect his completion, cost, and time required, and that all costs are included in the proposal.

B. Each Electrical Contractor and subcontractor shall examine all drawings and specifications of his trade and work shown on drawings, shop drawings and field layouts of all other trades (including Architectural, Structural, Mechanical and Electrical) working on the project prior to starting his required work, and coordination of all work with other trades.
C. All schedules on drawings and specifications are only for convenience of the Electrical Contractor. Each Electrical Contractor shall make his own count and, where fixtures or equipment are shown on drawings but not on schedule, provide like equipment or fixtures for like rooms or use.

1.07 QUALITY ASSURANCE, STANDARDS, AND SYMBOLS

A. General: Refer to Division 1 for general administrative/procedural requirements related to compliance with codes and standards. Specifically, for the electrical work (in addition to standards specified in individual work sections), the following standards are imposed, as applicable to the work in each instance:
   1. NEC (NFPA 70), National Electrical Code
   2. AWS, American Welding Society, Standards for Welding
   3. ANSI C2, National Electrical Safety Code
   4. ANSI C73, Dimensions of Attachment Plugs & Receptacles
   5. NECA, Standards for Installation
   6. NEMA, Standards for Materials and Products
   7. ASTM, American Society for Testing Materials
   8. ASA, American Standards Association
   9. NFPA, National Fire Protection Association
   10. UL, Underwriters' Laboratories, Inc.
   11. OSHA, Occupational Safety and Health Act
   12. ADA, Americans with Disabilities Act
B. NOTE: ALWAYS REFER TO THE MOST CURRENT STATE ADOPTED CODES AND STANDARDS.
C. All work to be provided and tested in accordance with all applicable local, county and state laws, ordinances, codes, rules, and regulations.
D. Where quantities, sizes, or other requirements on drawings or specifications are in excess of code requirements, drawings or specifications govern.
E. When conflict exists between referenced specifications or standards, more stringent requirements govern. No extra compensation for such compliance requirements shall be allowed.
F. No work shall be covered or enclosed until tested in accordance with applicable codes and regulations, and successful tests witnessed and approved by authorized inspection authority. Written approvals shall be secured by the Electrical Contractor and submitted to Engineer before final acceptance of work.
G. In general, all material where applicable shall be labeled or listed by Underwriters' Laboratories, Inc.
H. Permits and Fees: Give all notices, file all drawings, obtain necessary approvals, obtain all permits, pay all fees, deposits and expenses required for installation of all work under this Contract.

PART 2 PRODUCTS

2.01 PRODUCTS, ELECTRICAL WORK

A. General: Refer to Division 1 sections for general requirements on products, materials and equipment. The following provisions expand or modify the requirements as applicable to electrical work.
B. Compatibility: Provide products which are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with other work.
C. Standards:

1. All electrical material, equipment and accessories shall be new and conform to all applicable standards, codes and requirements and all applicable local, state and federal specifications.
2. All products shall be of established manufacturers regularly engaged in making type of materials to be provided and complete with all parts, accessories, connections, etc., reasonably incidental thereto as specified in detail or as described in manufacturer's catalog. All properly tested, cleaned, adjusted, lubricated and put in complete working order ready for service.

2.02 EXCAVATION AND BACKFILL FOR ELECTRICAL WORK

A. Description:
   1. The extent of excavating and backfill work required for electrical work is indicated on the Drawings and by Specifications, and is hereby defined to include whatever excavating and backfilling is necessary to install the electrical work specified in Division 26 of these Specifications.
   2. General: Coordinate the work with other excavating and backfilling in the same area, including dewatering, flood protection provisions and other temporary facilities. Coordinate the work with other work in the same area, including other underground services (existing and new), landscape development, paving and floor slabs on grade. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.

B. The types of electrical work installations requiring excavation and backfill include but are not necessarily limited to the following:
   1. Underground electrical wiring.
   2. Independent (isolated) equipment foundations specified as electrical work.

C. Materials: Refer to applicable provisions of Division 2 "Excavation and Backfill".

D. Execution:
   1. General Standards: Except as otherwise indicated, comply with the applicable provisions of Division 2 "Excavation and Backfill" for electrical work excavating and backfilling. Refer instances of uncertain applicability to the Engineer for resolution before proceeding.
   2. Excavation:
      a. General: Do not excavate for electrical work until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
      b. Excavate with vertical-sided excavations to the greatest extent possible, except where otherwise indicated. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Where not removed, cut sheeting off at a sufficient distance below finished grade to not interfere with other work.
      c. Width: Excavate to provide minimum practical but adequate working clearances.
      d. Depth for Subbase Support: Where installation of subbase material is indicated, excavate for installation of subbase material in the depth indicated or, if not indicated, 6" below bottom of work to be supported.
   3. Performance and Maintenance:
      a. Settling: Where settling is measurable or observable at electrical work excavations during the warranty period, remove the surface (pavement, lawn or other finish), add backfill material, compact and replace the surface treatment. Restore the appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of the restoration to the greatest extent possible.
   4. Where it is necessary to remove and replace landscape work, engage the original installer to install the replacement work. Where the work existed prior to the work of this Contract, engage only experienced and expert firms and trades persons to replace the work.

2.03 PAINTING

A. General Contractor will do all painting of electrical work in finished rooms per Architect's schedule.

B. All electrical equipment and accessories provided by Electrical Contractor shall have a factory baked enamel finish or as specifically stated otherwise.
C. Provide all exposed conduit and boxes in finished areas with surface suitable for painting.

2.04 FIRE STOPPING

A. Sealing of openings between floors, through rated fire and smoke wall, existing or created by the contractor for their work shall be the responsibility of the contractor.
B. Sealing material and application of this material shall be accomplished in such a manner which is acceptable to the local fire and building authorities having jurisdiction over this work.
C. Any openings created by or the contractor and left unused shall also be sealed as part of this work.
D. Refer to architectural Fire Stopping Specification as applicable.

2.05 CLEANING AND REPAIR

A. All equipment and accessories with baked enamel finish to be touched up with factory matching paint before final acceptance by Owner.
B. Where surface cannot be repaired by touching up, the entire scratched or marred equipment shall be electrostatically powder coated with finish to match original.

PART 3 EXECUTION

3.01 CERTIFICATE OF INSPECTION

A. Provide Engineer's office evidence that installation has been inspected and approved by municipal or state inspector having jurisdiction over electrical work involved.

3.02 RECORD DRAWINGS AND OPERATIONAL AND MAINTENANCE MANUALS

A. Maintain a white-print set of Electrical Contract Drawings and submittals in clean, undamaged condition for mark-up of actual installation on either Electrical Contract Drawings or submittals which vary substantially from the work as shown. Comply with additional Division 1 requirements relative to record drawings.
B. Contractor to provide copies of all Operational and Maintenance Manuals per specifications. Comply with additional Division 1 requirements relative to operational and maintenance manuals.
C. Contractor responsible for securing all elevations and locations prior to concealment.

3.03 PLACING SYSTEMS INTO OPERATION

A. General:
   1. Electrical Contractor shall be responsible for all start-up procedures, system checks and phase balancing, coordinating work of other Contractors and Subcontractors.
   2. All equipment installed, tested and operated in accordance with manufacturer's recommendations at normal operating conditions.
   3. All permanent electrical equipment used during construction periods shall be cleaned, and damaged equipment replaced.
   4. Place all systems into operation when weather or other considerations require their use. Perform repair, adjustment and balancing operations as often as required to assure satisfactory operation before final acceptance.

3.04 TESTING

A. All equipment shall be factory tested using industry standard testing procedures. Refer to individual specification sections for specific testing requirements.

3.05 GUARANTEE

A. Provide written guarantee for all work performed under this Contract for a period of not less than one year from the date of substantial completion.
B. Acceptance date of substantial completion shall be the date of Owner occupancy as defined by Architect/Engineer.
C. Contractor shall make all necessary alterations, repairs, and adjustments, replacements during guarantee period as directed by Architect/Engineer to comply with Drawings and Specifications at no cost to Owner.

D. Repair or replacements made under guarantee to bear further one year guarantee from date of acceptance of repair or replacement.

3.07 ELECTRICAL WORK CLOSEOUT

A. General: Refer to the Division 1 Sections for general closeout requirements.

B. Coordinate closeout operations with closeout of mechanical systems and other power consuming equipment as follows:
   1. Test run electrical equipment in coordination with test runs of mechanical systems.
   2. Clean and lubricate operational equipment.
   3. Instruct Owner's operating personnel thoroughly in the operation, sequencing, maintenance and safety/emergency provisions of the electrical systems.
   4. Turn over the operations to the Owner's personnel at the time(s) of substantial completion.
   5. Until the time of final acceptance of the total work of the Contract, respond promptly with consultation and services to assist the Owner's personnel with operation of electrical systems.

C. Conditions of Final Closeout:
   1. All completion checklists signed and returned to Engineer.
   2. Maintenance manuals submitted and approved.
   3. Record drawings submitted and approved.
   4. Final certificate of electrical inspection and Contractor's written 1 year warranty submitted and approved.
   5. Circuit directory in each panelboard. Electrical component identification complete.
   6. Equipment clean-up and final adjustments made.
   7. Contractor has instructed Owner's representative in the safe operation and use of the electrical systems.
   8. All temporary wiring and facilities have been removed.

END OF SECTION 16010

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PART 1 GENERAL

1.01 SECTION INCLUDES
A. Wire and cable for 600 volts and less.
B. Wiring connectors and connections.

1.02 RELATED SECTIONS
A. Section 024119 Selective Demolition
B. Section 031100 Site Clearing
C. Section 031200 Earth Moving
D. Section 16075 (26 0553) - Electrical Identification.

1.03 REFERENCES
A. Install per NECA (National Electrical Contractors Association)
B. Meet NEMA (National Electrical Manufacturers Association) standard requirements
C. Install per NFPA 70 (National Electrical Code; National Fire Protection Association

1.04 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
C. Products: Furnish products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 WIRING REQUIREMENTS
A. Concealed Dry Interior Locations: Use only building wire with Type THHN/THWN insulation in raceway.
B. Exposed Dry Interior Locations: Use only building wire with Type THHN/THWN insulation in raceway.
C. Above Accessible Ceilings: Use only building wire with Type THHN/THWN insulation in raceway.
D. Wet or Damp Interior Locations: Use only building wire with Type THHN/THWN insulation in raceway.
E. Exterior Locations: Use only building wire with Type THHN/THWN insulation in raceway.
F. Underground Installations: Use only building wire with Type THHN/THWN insulation in raceway, unless noted on plan.
G. Use stranded conductors for control circuits.
H. Use conductor not smaller than 12 AWG for power and lighting circuits.
I. Use conductor not smaller than 14 AWG for control circuits.
J. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

2.02 WIRE MANUFACTURERS
A. Cerro Wire & Cable Company: www.cerro.com.
B. Industrial Wire & Cable, Inc: www.industwire.com.
C. Southwire Company: www.mysouthwire.com.
D. Rome Cable Corporation.
E. Cablec.
F. Futronix Systems Corp.
G. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.

2.03 BUILDING WIRE
A. Description: Single conductor insulated wire.

B. Conductor: Copper.
C. Insulation Voltage Rating: 600 volts.
D. Insulation: Thermoplastic material rated 90 degrees C.

2.04 SERVICE ENTRANCE CABLE

A. Description: NFPA 70, Type SE.
B. Conductor: Copper.
C. Insulation Voltage Rating: 600 volts.
D. Insulation: Type NMC.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.
B. Verify that mechanical work likely to damage wire and cable has been completed.
C. Verify that raceway installation is complete and supported.
D. Verify that field measurements are as indicated.

3.02 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

A. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
B. Route wire and cable as required to meet project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
   3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.
C. Use wiring methods indicated.
D. Pull all conductors into raceway at same time.
E. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
F. Protect exposed cable from damage.
G. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
H. Use suitable cable fittings and connectors.
I. Neatly train and lace wiring inside boxes, equipment, and panelboards.
J. Clean conductor surfaces before installing lugs and connectors.
K. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
L. Terminate aluminum conductors with tin-plated aluminum-bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.
M. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
N. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
O. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
P. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
Q. Trench and backfill for direct burial cable installations. Install warning tape along entire length of direct burial cable.
R. Identify and color code wire and cable under provisions of Section 16075 (26 0553). Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing in Industry standards

B. Inspect and test in accordance with NETA STD ATS.
C. Perform inspections and tests listed in NETA STD ATS.

END OF SECTION 26 0519

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Grounding and bonding components.

1.02 RELATED SECTIONS
A. Section 03300 (03 3053) – Miscellaneous Cast-in-Place Concrete.

1.03 REFERENCES
A. Install per NFPA 70 – (National Electrical Code; National Fire Protection Association)

1.05 SUBMITTALS
A. See Section 16010 (26 0500) - Basic Electrical Requirements - Submittal procedures.

1.06 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING CONDUCTORS
A. Equipment grounding conductors shall be UL 83 insulated stranded copper, except that sizes 10AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes 4 AWG and larger shall be permitted to be identified per NEC.
B. Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 10AWG and smaller shall be ASTM B1 solid bare copper wire.
C. Electrical System Grounding: Conductor sizes shall not be less than what is shown on the drawings and not less than required by the NEC, whichever is greater.

2.02 GROUND CONNECTIONS
A. Below Grade: Exothermic-welded type connectors
B. Above Grade:
   1. Bonding jumpers: Compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
   2. Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

PART 3 EXECUTION

3.01 GENERAL
A. Verify existing conditions prior to beginning work.
B. Ground in accordance with the NEC, as shown on drawings, and as specified.

3.02 INSTALLATION
A. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

END OF SECTION 26 0526

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PART 1 GENERAL

1.01 SECTION INCLUDES
A. Conduit and equipment supports.
B. Anchors and fasteners.

1.02 REFERENCES
A. Install per NECA (National Electrical Contractors Association)
B. Install per NFPA 70 – (National Electrical Code; National Fire Protection Association)

1.03 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Thomas & Betts Corporation.
B. Threaded Rod Company.
C. Erico.
D. Threadco.
E. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.

2.02 MATERIALS
A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
B. Supports: Fabricated of structural steel or formed steel members; galvanized.
C. Anchors and Fasteners:
   1. Do not use powder-actuated anchors, spring clips, or beam clamps.
   2. Obtain permission from Architect before using powder-actuated anchors.
   3. Concrete Structural Elements: Use precast inserts, expansion anchors, powder-actuated anchors, or preset inserts.
   4. Steel Structural Elements: Use beam clamps, steel spring clips, steel ramset fasteners, or welded fasteners.
   5. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
   6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
   7. Solid Masonry Walls: Use expansion anchors or preset inserts.
   8. Sheet Metal: Use sheet metal screws.
   9. Wood Elements: Use wood screws.
D. Formed Steel Channel:
E. Steel Spring Clips:

PART 3 EXECUTION

3.01 INSTALLATION
A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
   1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
   2. Do not drill or cut structural members.
   3. Obtain permission from Architect before drilling or cutting structural members.
B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with

adequate strength and rigidity. Use spring lock washers under all nuts.

C. Install surface-mounted cabinets and panelboards with minimum of four anchors.
D. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1 inch off wall.
E. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION 26 0529

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Wall and ceiling outlet boxes.
B. Pull and junction boxes.

1.02 RELATED SECTIONS
A. Section 16010 (26 0500) – Basic Electrical Requirements - Firestopping.
B. Section 16139 (26 2716) - Cabinets and Enclosures.
C. Section 16140 (26 2726) – Wiring Devices: Wall plates in finished areas.
D. Section 16155 (26 2717) – Equipment Wiring.

1.03 REFERENCES
A. Install per NECA (National Electrical Contractors Association)
B. Meet NEMA (National Electrical Manufacturers Association) standard requirements
C. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)

1.04 SUBMITTALS
A. See Section 16010 (26 0500) - Basic Electrical Requirements - Submittal procedures.
B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Provide products listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Appleton Electric
B. Arc-Co./Division of Arcade Technology
C. Unity Manufacturing
D. Raco
E. Thomas & Betts (Steel City)
F. Hubbell
G. Quazite
H. Wiremold
I. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.

2.02 OUTLET BOXES
A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2-inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.
B. Nonmetallic Outlet Boxes: NEMA OS 2.
C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
D. Wall Plates for Finished Areas: As specified in Section 16140 (26 2726).

2.03 PULL AND JUNCTION BOXES
A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
B. Hinged Enclosures: As specified in Section 16139 (26 2716).
C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
1. Material: Galvanized cast iron.
2. Cover: Smooth cover with neoprene gasket and stainless-steel cover screws.
3. Cover Legend: "ELECTRIC"

E. In-Ground Fiberglass Handholes: Die molded fiberglass
1. Cable Entrance: Pre-cut 4x4 inch cable entrance at center bottom of each side.
2. Cover: weatherproof fiberglass, nonskid finish
3. Cover Legend: Refer to plans and details.
4. Hardware: Stainless steel inserts and bolts

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify locations of outlets in work areas prior to rough-in.

3.02 INSTALLATION

A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
C. Coordinate installation of outlet boxes for equipment connected under Section 16155 (26 2717).
D. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
E. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
1. Adjust box locations up to 10 feet if required to accommodate intended purpose, obtain approval from Architect prior to installation.
F. Orient boxes to accommodate wiring devices oriented as specified in Section 16140 (26 2726).
G. Maintain headroom and present neat mechanical appearance.
H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
I. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
J. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 16010 – Fire Stopping.
K. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
L. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan and elevations.
M. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
N. Use flush mounting outlet box in finished areas.
O. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
P. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.
Q. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
R. Use stamped steel bridges to fasten flush mounting outlet box between studs.
S. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
T. Use adjustable steel channel fasteners for hung ceiling outlet box.
U. Do not fasten boxes to ceiling support wires.
V. Support boxes independently of conduit.
W. Use gang box where more than one device is mounted together. Do not use sectional box.
X. Use gang box with plaster ring for single device outlets.
Y. Use cast outlet box in exterior locations exposed to the weather and wet locations.
Z. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal

box in other locations.

AA. Handholes:
   1. Do all excavation. Bottom of excavation shall be undisturbed earth. If earth is disturbed, backfill with sand and compact.
   2. Set per manufacturers recommendations.
   3. Backfill shall be compacted to 95% Procter density. Remove all excess material from site.
   4. Restore all disturbed surfaces to their original condition.

3.03 ADJUSTING

A. Install knockout closures in unused box openings.
B. Adjust handholes such that cover is 1/4" above grade.

END OF SECTION 26 0533

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PART 1 GENERAL

1.01 SECTION INCLUDES
A. Conduit, fittings and conduit bodies.

1.02 RELATED SECTIONS
A. Section 02582 (33 7119) - Underground Electrical Ducts and Manholes.
B. Section 16010 (26 0500) - Basic electrical requirements.
C. Section 16060 (26 0526) - Grounding and Bonding.
D. Section 16070 (26 0529) - Hangers and Supports.
E. Section 16075 (26 0553) - Electrical Identification.
F. Section 16138 (26 0537) - Boxes.

1.03 REFERENCES
A. Meet ANSI (American National Standard) standard requirements
B. Install per NECA (National Electrical Contractors Association)
C. Meet NEMA (National Electrical Manufacturers Association) standard requirements
D. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)

1.04 SUBMITTALS
A. Project Record Documents: Accurately record actual routing of conduits larger than 1-1/4 inches.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Accept conduit on site. Inspect for damage.
B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.01 CONDUIT REQUIREMENTS
A. Conduit Size: Comply with NFPA 70.
   1. Minimum Size: 3/4 inch unless otherwise specified.
B. Underground Installations:
   1. More than Five Feet from Foundation Wall: Use thinwall non-metallic conduit.
   2. Within Five Feet from Foundation Wall: Use thickwall nonmetallic conduit.
   3. Roadway: Use thick wall non-metallic conduit.
C. Outdoor Locations Above Grade: Use rigid steel conduit.
D. Wet and Damp Locations: Use rigid steel conduit.
E. Dry Locations:
   1. Concealed: Use electrical metallic tubing.
   2. Exposed:
      a. In unfinished spaces below 8’-0” A.F.F.: Use intermediate metal conduit.
      b. In unfinished spaces above 8’-0” A.F.F.: Use electrical metallic tubing.
      c. In all finished spaces use electrical metallic tubing unless noted on plan

2.02 METAL CONDUIT
A. Manufacturers:
   1. Allied Tube & Conduit
   2. Beck Manufacturing, Inc.
   3. Wheatland Tube Company

4. Substitutions: See Section 06010 (26 0500) – Basic Electrical Requirements: Product Substitutions.

B. Rigid Steel Conduit: ANSI C80.1.
C. Rigid Aluminum Conduit: ANSI C80.5.
D. Intermediate Metal Conduit (IMC): Rigid steel.
E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.03 PVC COATED METAL CONDUIT

A. Manufacturers:
   1. Allied Tube & Conduit
   2. Thomas & Betts Corp
   3. Robroy Industries
   4. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.
B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil thick.
C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.04 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit
   2. Beck Manufacturing, Inc
   3. Wheatland Tube Company
   4. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.
B. Description: ANSI C80.3; galvanized tubing.
C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron set screw type.

2.05 NONMETALLIC CONDUIT

A. Manufacturers:
   1. AFC Cable Systems, Inc
   2. Electri-Flex Company.
   3. International Metal Hose.
   4. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.
B. Thin Wall Description: NEMA TC 2; Schedule 40 PVC.
C. Thick Wall Description: NEMA TC2; Schedule 80 PVC
D. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on drawings.
B. Verify routing and termination locations of conduit prior to rough-in.
C. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.
B. Install steel conduit as specified in NECA 101.
C. Install nonmetallic conduit in accordance with manufacturer's instructions.
D. Arrange supports to prevent misalignment during wiring installation.
E. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
G. Fasten conduit supports to building structure and surfaces under provisions of Section 16070

(26 0529).

H. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
I. Do not attach conduit to ceiling support wires.
J. Arrange conduit to maintain headroom and present neat appearance.
K. Route exposed conduit parallel and perpendicular to walls.
L. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
M. Route conduit under slab, where permitted, from point-to-point.
N. Do not cross conduits in slab.
O. Maintain adequate clearance between conduit and piping.
P. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
Q. Cut conduit square using saw or pipecutter; de-burr cut ends.
R. Bring conduit to shoulder of fittings; fasten securely.
S. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
T. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations.
U. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch size.
V. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
W. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
X. Provide suitable pull string in each empty conduit except sleeves and nipples.
Y. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
Z. Ground and bond conduit under provisions of Section 16060 (26 0526).
AA. Identify conduit under provisions of Section 16075 (26 0553).
AB. All conduit shall be concealed in finished areas unless otherwise noted.
AC. Do not install horizontal runs of conduit in masonry walls.
AD. Use rigid, coated EMT 90º bends in all underground conduit.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods as referenced in Section 16010.
B. Install conduit to preserve vapor retarder and air infiltration barrier in exterior walls and floor penetrations.
C. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

END OF SECTION 26 0534

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PART 1 GENERAL

1.01 SECTION INCLUDES
A. Nameplates and labels.
B. Wire and cable markers.
C. Conduit markers.
D. Field-painted identification of conduit.

1.02 REFERENCES
A. NFPA 70 - National Electrical Code; National Fire Protection Association

1.03 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Brady Corporation.
B. Seton Identification Products.
C. Hellermann Tyton.
D. Substitutions: See Section 16010 (26 0500) Basic Electrical Requirements: Product Substitutions

2.02 NAMEPLATES AND LABELS
A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
B. Locations:
   1. Each electrical distribution and control equipment enclosure.
   2. Panelboards.
   2. Communication cabinets.
C. Letter Size:
   1. Use 1/8 inch letters for identifying individual equipment and loads.
   2. Use 1/4 inch letters for identifying grouped equipment and loads.
D. Receptacle and switch plates shall be identified on the back side by the panel and circuit serving the device.

2.03 WIRE MARKERS
A. Description: Cloth, tape, split sleeve, or tubing type wire markers.
B. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
C. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. For 120/240 volt and 3-phase systems, wire colors to be black, red, blue and white grounded conductors.

2.04 JUNCTION BOXES
A. Identify junction box covers with a permanent readable marker, indicating circuits contained within or noting the system type for low voltage systems.

2.05 UNDERGROUND WARNING TAPE
A. Description: 4 inch wide plastic tape, detectable type colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install nameplates and labels parallel to equipment lines.
B. Secure nameplates to equipment front using screws or rivets.
C. Secure nameplates to inside surface of door on panelboard that is recessed in finished locations.
D. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.
E. All panelboard directories are to be typed.

END OF SECTION 26 0553

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Power distribution panelboards.

1.02 RELATED SECTIONS
A. Section 26 0526 - Grounding and Bonding.
B. Section 26 0553 - Electrical Identification..

1.03 REFERENCES
A. Meet NEMA (National Electrical Manufacturers Association)
B. Install per NECA (National Electrical Contractors Association)
C. Install per NFPA 70 – (National Electrical Code; National Fire Protection Association)

1.04 SUBMITTALS
A. See Section 26 0500 - Basic Electrical Requirements - Submittal procedures.
B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
C. 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 of product.
D. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
E. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.
C. All equipment specified within shall be of the same manufacturer.
D. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.06 MAINTENANCE MATERIALS
A. Furnish six of each panelboard key.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Cutler-Hammer/Eaton Corporation
B. GE Company
C. Square D Company
D. Siemens ITE
E. Substitutions: See Section 26 0500 – Basic Electrical Requirements: Product Substitutions.

2.02 POWER DISTRIBUTION PANELBOARDS
A. Description: NEMA PB 1, circuit breaker type.
B. Panelboard Bus: Aluminum, ratings as indicated. Provide aluminum ground bus in each panelboard.
C. Provide 100% neutral buss unless noted otherwise.
D. Minimum integrated short circuit rating:
   1. 240 Volt Panelboards: 22,000 amperes rms symmetrical.
   2. 480 Volt Panelboards: 22,000 amperes rms symmetrical.
E. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to

accommodate Class R fuses.

F. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
G. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
H. Enclosure: NEMA PB 1, unless noted otherwise.
I. Cabinet Front: Surface type, fastened with hinge and latch, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.
B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
C. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
D. Provide filler plates for unused spaces in panelboards.
E. Provide typed handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
F. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
G. Provide engraved plastic nameplates under the provisions of Section 26 0553.
H. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
    1. Minimum spare conduits: 5 empty 1 inch.
I. Ground and bond panelboard enclosure according to Section 26 0526.
J. In commercial kitchens all equipment under the hood shall have shunt trip breakers. All equipment in the kitchen shall be GFI protected. Provide breakers and/or GFI receptacles to meet the requirements per the NEC.

3.02 FIELD QUALITY CONTROL

A. Inspect and test per manufacturer’s recommendations.

3.03 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 10 percent of each other. Maintain proper phasing for multi-wire branch circuits.

3.04 CLEANING

A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION 26 2416

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Wall switches
B. Wall dimmers
C. Receptacles
D. Device plates and decorative box covers

1.02 RELATED SECTIONS
A. Section 16138 (26 0533) - Boxes.

1.03 REFERENCES
A. Install per NECA (National Electrical Contractors Association)
B. Meet NEMA (National Electrical Manufacturers Association) standard requirements
C. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)

1.04 SUBMITTALS
A. See Section 16010 (26 0500) - Basic Electrical Requirements - Submittal procedures.
B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
C. Manufacturer's Installation Instructions.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Products: Provide products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
D. comply with Nema standard WD-1 “general purpose wiring devices”

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Wiring Devices - Ivory
   1. Cooper Wiring Devices (Arrow Hart)
   2. GE Wiring Devices
   3. Leviton Manufacturing, Inc
   4. Hubbell Inc.
   5. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions.
B. Multi-outlet assemblies - Ivory
   1. Wiremold
   2. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements: Product Substitutions

2.02 WALL SWITCHES
A. Wall Switches: Heavy Duty, AC only general-use snap switch
   1. Manufacturer:
      a. Leviton CSB1 or approved equal.
   2. Body and Handle: Ivory plastic with toggle handle.
   3. Indicator Light: Lighted handle type switch; red handle.
   4. Ratings:
      a. Voltage: 120-277 volts, AC.
      b. Current: 20 amperes.
B. Switch Types: Single pole, double pole, 3-way,4-way and pilot.

2.04 RECEPTACLES

A. Receptacles: Heavy duty
   1. Device Body: plastic
   2. Configuration: Refer to plans and as specified
B. Duplex Convenience Receptacles: Type 5 – 20R.
   1. Manufacturer:
      a. Leviton 5801 or approved equal
C. Single Convenience Receptacles: Type 5-20R.
   1. Manufacturer:
      a. Leviton 5801 or approved equal.
D. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. 5-20R
   1. Manufacturer:
      a. Leviton 6898 or approved equal.

2.05 WALL PLATES

A. Cover Plates: smooth flexible nylon plastic in finished spaces. (Ivory).
B. Cover Plates: Galvanized steel plates in unfinished spaces.
C. Cover Plates: Smooth stainless steel in kitchen areas.
D. Weatherproof Cover Plates: Gasketed cast metal with gasketed in use device cover.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that outlet boxes are installed at proper height.
B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean debris from outlet boxes.

3.03 INSTALLATION

A. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
B. Install devices plumb and level.
C. Install switches with OFF position down.
D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
E. Do not share neutral conductor on load side of dimmers.
F. Do not share neutrals on dedicated circuits.
G. Install receptacles with grounding pole on top.
H. Connect wiring device grounding terminal to outlet box with bonding jumper.
I. For Isolated Ground receptacles (IG), connect wiring device grounding terminal only to branch circuit isolated equipment grounding conductor.
J. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
K. Connect wiring devices by wrapping conductor around screw terminal.
L. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
M Install protective rings on active flush cover service fittings.
N. Where more than one wall switch is installed in same location, set under one cover plate.
O. Make any necessary adjustments to the system at no charge to the Owner during warranty period.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 16138 (26 0533) to obtain mounting heights specified.
B. Install wall switch 48 inches above finished floor.
C. Install convenience receptacle 18 inches above finished floor.

D. Install convenience receptacle 6 inches to center above backsplash of counter when noted on plan as "AC". Verify exact location with Architectural drawings.
E. Install dimmer 48 inches above finished floor.

3.05 FIELD QUALITY CONTROL

A. Perform Manufacturers standard field inspection, testing, and adjusting
B. Inspect each wiring device for defects.
C. Operate each wall switch with circuit energized and verify proper operation.
D. Verify that each receptacle device is energized.
E. Test each receptacle device for proper polarity.
F. Test each GFCI receptacle device for proper operation.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 2726

ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fusible switches.
B. Nonfusible switches.

1.02 RELATED SECTIONS
A. Section 26 0529 - Hangers and Supports.
B. Section 26 0553 - Electrical Identification: Engraved nameplates.

1.03 REFERENCES
A. Meet NEMA (National Electrical Manufacturers Association) standard requirements
B. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)

1.04 SUBMITTALS
A. See Section 26 0500 - Basic Electrical Requirements - Submittal procedures.
B. Product Data: Provide switch ratings and enclosure dimensions.
C. Project Record Documents: Record actual locations of enclosed switches.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.
C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Cutler-Hammer/Eaton Corporation
B. GE Company
C. Square D Company
D. Siemens ITE
E. Substitutions: See Section 26 0500 – Basic Electrical Requirements: Product Substitutions.

2.02 COMPONENTS
A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.
   3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
   1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
   2. Handle lockable in OFF position.
C. Enclosures: NEMA KS 1.
   1. Interior Dry Locations: Type 1.
   2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install fuses in fusible disconnect switches per manufacturer’s nameplate rating.
C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

A. Inspect and test each switch per manufacturer's recommendations.

END OF SECTION 26 2818

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Interior luminaires and accessories
B. LED Drivers
C. Emergency power supply
D. Emergency Transfer Device

1.02 RELATED SECTIONS
A. Section 01 91 01 or 01 91 02 – Commissioning Process
B. Section 26 27 26 – Wiring Devices

1.03 REFERENCES
A. Meet ANSI (American National Standard) standard requirements
B. Install per NECA (National Electrical Contractors Association)
C. Meet NEMA (National Electrical Manufacturers Association) standard requirements
D. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)
E. Install per NFPA 101 (Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association)
F. RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
G. DLC.
H Energy Star.
I. LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
J. LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
K. TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
L. NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

1.04 DESCRIPTION OF WORK
A. The work under this section includes interior luminaires and accessories, exit signs, and building-mounted exterior lighting.

1.05 COORDINATION
A. Coordinate with Architectural ceiling plans for mounting of fixture types.

1.06 SUBMITTALS
A. See Section 26 0500 - Basic Electrical Requirements - Submittal procedures.
B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
C. Verify the type of ceiling and suspension method prior to ordering fixtures.
D. Product Data: For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers and required accessories:
- Luminaire:
  - Manufacturer and catalog number,
  - Type (identification) as indicated on the plans and schedule,
  - Delivered lumens,
  - Input watts,
  - Efficacy,
  - Color rendering index.
- Driver:
  - Manufacturer and catalog number,

- Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
- Power Factor, Crest Factor, THD, etc.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
F. Operation and Maintenance Data: Instructions for each product.

1.07 QUALITY ASSURANCE

A. Conform to requirements of NFPA 70 and NFPA 101.
B. LED Luminaires shall meet all Design Lights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the Design Lights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
   - Minimum Light Output.
   - Zonal Lumen Requirements.
   - Minimum Luminaire Efficacy.
   - Minimum CRI.
   - L70 Lumen Maintenance.
   - Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
C. Energy Star Listed.
D. Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).
E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' experience.
F. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.08 UNIT PRICING

A. Provide unit pricing for all single name specification fixture types.

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Furnish products as indicated in Schedule included on the Drawings. If the fixture designation is omitted from a light fixture, assume a fixture of the type used in similar areas in preparing Bid. Confirm type with Owner's Representative prior to ordering.
B. Substitutions: See Section 26 0500 – Basic Electrical Requirements: Product Substitutions.
   1. Pre-Qualification of contractor –offered substitutions are required (7 days prior to bid date. Failure to submit within the deadline constitutes a guarantee that only the base specified product(s) will be supplied and no other products will be considered.
      Provide calculations showing performance of proposed fixture, coordinate with engineer for reflectance's and architectural components that may affect light level, and provide photometric file in .ies format to Engineer.Provide PDF submittal of proposed substitution to engineer.
C. Refer to fixture schedule for lamping of fixture. Manufacturer to label all fixtures as maximum allowable socket wattage per lamping noted in schedule. This is for current and future LEED documentation purposes.

2.02 LED LUMINAIRES

A. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
B. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
C. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
D. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

E. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
F. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
G. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
H. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
I. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires or as noted on light fixture schedule.
J. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
K. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
L. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
M. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
N. All luminaires shall be provided with knockouts for conduit connections.
O. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
P. Provide all of the following data on submittals:
    a. Delivered lumens
    b. Input watts
    c. Efficacy
    d. Color rendering index.
Q. The failure of one LED shall not affect the operation of the remaining LEDs.
R. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

2.03 LED DRIVERS

A. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
B. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
C. Driver shall have a rated life of 50,000 hours, minimum.
D. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
E. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
F. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
G. Driver shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
H. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
I. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
J. Provide all of the following data on submittals:
    a. Input watts
    b. Power Factor (pf)
    c. Crest Factor (cf) at full input power
    d. Total Harmonic Distortion (THD).
K. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
L. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire’s light output equally.

M. Continuous Dimming Drivers: LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
B. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
C. Support luminaires larger than 2 x 4-foot size independent of ceiling framing, unless local codes require all fixtures to be supported independent of ceiling framing.
D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
E. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
F. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
G. Install recessed luminaires to permit removal from below.
H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
I. Install clips to secure recessed grid-supported luminaires in place.
J. Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated on Drawings.
K. Install accessories furnished with each luminaire.
L. Connect luminaires and exit signs to branch circuit outlets provided under Section 26 0537 as indicated.
M. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
N. Bond products and metal accessories to branch circuit equipment grounding conductor.
O. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
P. Install downlights with clean gloves on. No fingerprints should be seen on downlight reflectors.
Q. Dimmed luminaire circuits shall have separate neutrals.
S. Dimmed LED luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don’t “glow” at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.
T. Fixtures shall not be turned on unless temperatures are above 50 degrees unless cold weather rated ballasts are utilized.
U. Provide controls as indicated on the plans. Controls shall be compatible with the drivers being installed.

3.02 ZERO-TO-10V DIMMING CONTROL WIRING INSTALLATION

A. Zero-to-10V dimming control conductors are classified by the NEC as Class 2 conductors and shall be kept separate from line-voltage conductors per NEC 725.136(A). Matching the insulation rating of Conductors of Different Systems does not apply to Class 2 conductors per NEC 300.3(C)(1), Informational Note No.1.
B. Wall box dimmers will typically have two conduits: One conduit for line-voltage power, and one conduit or conduit stub for the 0-10V control wiring.
C. The 0-10V wiring may be routed in free air if:
    - The room is approximately 900 sq.ft. or less,
    - The 0-10V wiring stays within the room,
    - The ceiling space is a non-plenum space, and
    - All splices of 0-10V wiring are spliced in a box.

- The 0-10V wiring may be tie-wrapped to the outside of the luminaire fixture whip per NEC 300.11(B)(2). Tie-wraps shall be UL listed for UV resistance.

D. At each luminaire, separate openings (either manufactured knock-outs or punched openings) shall be used for the line-voltage power and the 0-10V wiring. The EC shall use an NM cable connector at the opening for the 0-10V wiring. Zero-to-10V conductors entering and within a luminaire enclosure shall maintain a minimum separation of 6 mm (0.25 in.) per NEC 725.136(D).

E. Metal-Clad (MC) type cable that combines power and Class 2 circuits into a single cable may be used for the luminaire wiring within a single room. Examples of such products are Encore Wire® MC-LED™ or Southwire® MC-PCS Duo™. Manufacturer's names and catalog numbers are used for quality and performance only. MC Cables manufactured by others shall be equally acceptable provided they meet or exceed in performance and quality as specified.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection to verify all fixtures are operational.
B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.04 ADJUSTING

A. Aim and adjust luminaires as directed.
B. Position exit sign directional arrows as indicated.
C. Coordinate adjustment of integral light sensors with lighting control system.

3.05 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.
B. Remove dirt and debris from enclosures.
C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.

3.06 PROTECTION

A. Relamp luminaires that have failed lamps at Substantial Completion.
B. All lamps shall be stored horizontally

.

3.07 SCHEDULE - See Drawings

END OF SECTION 26 5113

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Exterior luminaires and accessories.

1.02 RELATED SECTIONS
A. Section 03300 (03 3053) – Miscellaneous Cast-in-Place Concrete.

1.03 REFERENCES
A. Meet ANSI (American National Standard) standard requirements
B. Install per NECA (National Electrical Contractors Association)
C. Meet NEMA (National Electrical Manufacturers Association) standard requirements
D. Install per NFPA 70 (National Electrical Code; National Fire Protection Association)

1.04 SUBMITTALS
A. See Section 16010 (26 0500) - Basic Electrical Requirements - Submittal procedures.
B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard product of the manufacturer.
C. Product Data: Provide dimensions, ratings, and performance data.
D. Test Reports: Indicate measured illumination levels.
E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
F. Operation and Maintenance Data: Instructions for each product.

1.05 QUALITY ASSURANCE
A. Conform to requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years experience.
C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Store and handle poles per manufacturer’s recommendations.

PART 2 PRODUCTS

2.01 LUMINAIRES
A. Furnish products as indicated in Schedule included on the Drawings.
B. Substitutions: See Section 16010 (26 0500) – Basic Electrical Requirements - Substitutions.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 501.
B. Provide concrete bases for lighting poles at locations indicated, in accordance with Section 03300 (03 3000).
C. Install poles plumb.
   1. Provide double nuts to adjust plumb.
   2. Grout around each base.
D. Install lamps in each luminaire.
E. Bond luminaires, metal accessories, and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.
F. Provide fusing in base of pole.
G. Do not install poles without fixtures without written approval from manufacturer

3.02 FIELD QUALITY CONTROL

A. Perform field inspection to verify all fixtures are operational.
B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

3.03 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.
B. Remove dirt and debris from enclosure.
C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.

3.06 SCHEDULE – Refer to Drawings

END OF SECTION 26 5600

FORMS/STATEMENTS

AGREEMENT FORM

THIS AGREEMENT made this ____ day of _____ in the year 2024, by and between **City of Muskegon**, Party of the First Part, hereinafter called the Owner, and _____, hereinafter called the Contractor, Party of the Second Part.

WITNESSETH that in consideration of the covenants of agreements hereinafter mentioned, to be performed by the parties hereunto and of the payments herein agreed to be made, it is mutually agreed as follows: The Contractor shall furnish all the materials, superintendence, labor, equipment, and transportation, and shall execute, construct, and finish, in an expeditious, substantial, and workmanlike manner to the satisfaction and acceptance of MCSA Group, Inc., hereinafter called the Landscape Architect, the improvements at Pere Marquette South Restroom on which he has proposed a price. The above referred to work shall be executed from materials furnished in accordance with the accompanying plans, which it is agreed are with the Proposal, General Conditions, and Technical Specifications herein enclosed, and made a part of this Contract.

The work covered by this Contract shall be commenced no later than five (5) days from the date this Contract is signed by the Owner. All work must be completed in accordance with the Information for Bidders. If all work is not completed by _____, the Contractor will be responsible for all Damages for Non-Completion, as per section 32 of the General Conditions.

And in consideration of the conclusion of the work herein and the fulfillment of all stipulations of this Agreement to the satisfaction and acceptance of the Landscape Architect, said Owner shall pay or cause to be paid to said Contractor, the amounts due the Contractor, based on the prices named on the preceding proposal in the complete amount of $000,000.00 for those proposal items as accepted by the Owner and listed on Page A - 2 of this Agreement Form.

IN WITNESS WHEREOF, the parties to this Agreement have hereunto set their hands and seals; dated the day and year first written.

OWNER – City of Muskegon

_____ By _____
Witness to Signature of Party of the First Part
Party of the First Part

CONTRACTOR –

_____ By _____
Witness to Signature of Party of the Second Part
Party of the Second Part

Bid Proposal Items accepted by the Owner:

QUALIFICATION STATEMENT

Each bidder will be requested to submit qualifications in accordance with the following questions:

All questions shall be answered and the data given must be clear and comprehensive. The bidder may submit any additional information he desires.

1. Name of bidder.
2. Permanent main office address.
3. When organized.
4. If a corporation, where incorporated.
5. How many years have you been engaged in and worked under your present or trade name?
6. Contracts on hand: (Schedule these, showing gross amount of each contract and the appropriate anticipated dates of completion).
7. General character of work performed by you, i.e. total gross sales of the year, percentage and percentage by subcontractors, breakdown by categories.
8. Have you ever defaulted on a contract? If so, where and why?
9. Have you ever failed to complete any work awarded to you? If so, where and why.
10. List five contracts recently completed by you, starting approximate gross cost for each, and the month and year completed. Provide names and telephone numbers of Owners and/or architects for same.
11. List your major equipment available for this contract.
12. Experience in construction of work similar in scale to this project.
13. Background and experience of the principal members of your organization, including the officers.
14. Give bank and supplier references.
15. Percentage and types of work to be performed by your people and percentages and types of subcontractors.
16. List subcontractors to be used on this work.
17. Completion and submittal of all the above questions by your subcontractors may be requested from the successful bidder.
18. Sign and date this data and all attachments.

PROGRESS SCHEDULE

Schedule to be provided upon notification of contract award.

Project Name: Pere Marquette South Restroom Building

OUTLINE OF PROPOSED ORDER OF WORK FOR MAJOR ITEMS INCLUDED IN PROPOSAL -

If approved, this outline will become part of the contract.

Item of Work	Proposed Starting Date	Proposed Completion Date

CONTRACTOR: **BY:** **DATE:**

Bidder Company Name_____

PROPOSAL FORM
Pere Marquette South Restroom Building
City of Muskegon, Michigan

TO: Dan VanderHeide, PE
Public Works Director
City of Muskegon
1350 E. Keating Ave.
Muskegon, Mi 49442

The undersigned bidder has carefully examined the plans and specifications for the construction of the Pere Marquette South Restroom in Muskegon, Michigan, as prepared by M. C. Smith Associates and Architectural Group, Inc. and, having carefully examined the site and completely familiarized himself with local conditions affecting the cost of the work; hereby states that he will provide all necessary labor, equipment, tools, machinery, apparatus and all other means of construction, do all the work and furnish all materials called for by said plans and specifications in the manner prescribed by in accordance with the requirements of the contract, specifications and drawings; and will accept as full and complete payment therefore the Lump Sum Bid Amount Which Is The Summation Of The Cost Of The Items Of Work And Must Be Equal To The Summation Of The Extension Of The Unit Prices in the amount of :

_____ Dollars

and _____ Cents ($)

This is not a unit price contract. The following unit prices will be utilized to assess bids, revise contract amounts, and develop change orders. Bidders must provide unit prices for every bid item at the time the bid is submitted. The Base Bid amount must be equal to the summation of the extension of all unit prices; Items (1) through (24). Bids which are incomplete or inaccurate will be subject to disqualification.

Bidders shall immediately notify the Landscape Architect of any perceived errors, omissions or discrepancy in the bid item quantities so they and other bidders can be advised of an acceptable bid procedure. This is a Lump Sum Bid. The base bid as submitted is for complete construction as shown by the plans, details and specifications.

The bidder agrees to reduce or add to the amount of the Base Bid under this proposal for any items deleted or added in accordance with the following unit prices. These unit prices shall include overhead and profit for each associated work item.

GENERAL CONDITIONS

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
1.	Mobilization and maintaining traffic complete.	1	LS	$	$
2.	The cost of project related bonds and insurance.	1	LS	$	$
3.	All layout and staking of site work elements complete.	1	LS	$	$
4.	General conditions: management, overhead and profit. Unit price shall be equal to 5% of the total base bid.	1	LS	$	$

SITE PREPARATION AND REMOVALS

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
5.	Site Preparation and Grading including Soil Erosion, Sedimentation Control and all other work shown on the plans but not otherwise listed below.	1,095	SY	$	$
6.	Sawcut and Remove Concrete paving per plans and specifications.	1,330	SF	$	$
7.	Sawcut and Remove Bituminous paving per plans and specifications.	250	SY	$	$
8.	Relocate Swing Bench as per plans and specifications.	1	LS	$	$

GENERAL SITE IMPROVEMENTS

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
9.	Furnish and install Bituminous Paving and striping complete as per detail no. 2 and 6 on sheet L4 and per plans and specifications.	231	SY	$	$
10.	Furnish and install 6” Concrete paving per detail no. 1 on sheet L4 and per plans and specifications.	2,983	SF	$	$
11.	Furnish and install Valley Gutter including flared end section as per detail no. 5 on sheet L4 and per plans and specifications.	91	LF	$	$
12.	Furnish and install Sheet Pile Wall as per detail no. 7 on sheet L4 and per plans and specifications.	104	LF	$	$
13.	Furnish and install Traffic Signs as per detail no. 4 on sheet L4 and per plans and specifications.	3	EA	$	$

RESTROOM BUILDING

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
14.	Furnish and install Restroom Building Complete including Architectural, Electrical, Plumbing and Mechanical plans and per plans and specifications.	730	SF	$	$
15.	Furnish and install Renovations to Kite Shop Complete including Architectural, Electrical, Plumbing and Mechanical plans per plans and specifications.	418	SF	$	$

SITE EQUIPMENT

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
16.	Furnish and install ADA Shower per plans and specifications.	1	EA	$	$
17.	Furnish and install Trash and Recycle Containers per plans and specifications.	2	EA	$	$

SITE UTILITIES

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
18.	Furnish and install 6" sanitary sewer as per sheet C2 and per plans and specifications.	2	LF	$	$
19.	Furnish and Install sanitary Wye as per sheet C2 and per plans and specifications	1	EA	$	$
20.	Furnish and install 2" copper water service as per sheet C2 and per plans and specifications	61	LF	$	$
21.	Furnish and install 1" copper water service as per sheet C2 and per plans and specifications	21	LF	$	$
22.	Furnish and install water service, curb stop and box as per sheet C2 and per plans and specifications	1	EA	$	$
23.	Furnish and install water service 2" x 2" x2" tee as per sheet C2 and per plans and specifications	1	EA	$	$

SITE LIGHTING AND ELECTRICAL

Item No.	Description	Qty.	Unit *	Installed Unit Price	Unit Total
24.	Site Electrical Service and Distribution complete to Restroom and Kite Shop Building per plans and specifications.	1	LS	$	$

Total Base Bid	$

Bidder Company Name_____

LIST OF SUBCONTRACTORS

LIST ALL SUBCONTRACTORS: To be completed as part of Bid Proposal.

Name of Subcontractor	Type of Work	Amount

The undersigned agrees as follows:

To do any extra work not covered by the above schedule of prices, which may be ordered by the Landscape Architect, and to accept compensation therefore as provided in Section 23 of the General Conditions entitled "Unclassified Work".

Begin work as soon as possible after the contract is executed and perform said work in such a manner as to complete it in accordance with Section 18 of the Information to Bidders and to coordinate their work with the other contractors involved.

The undersigned acknowledges the right of the Owner to accept or reject any proposal or part of any proposal submitted.

We hereby acknowledge receipt of the following addenda and have included them in our proposal; Addenda Nos._____

_____Dated_____

Dated this_____day of_____, 2024.

By: Signature of Bidder_____

Name of Business_____

Business Address of Bidder _____

_____

Business Telephone of Bidder_____

Business Fax Number of Bidder_____

Incorporated under the laws of the State of_____

President_____

Secretary_____

Treasurer_____

If Non-incorporated:_____

Names and Addresses of Members of the Firm:

_____

_____

_____

_____

_____

APPENDIX A

SOILS & STRUCTURES

REPORT OF THE GEOTECHNICAL INVESTIGATION FOR PERE MARQUETTE SOUTH RESTROOM

MUSKEGON
MUSKEGON COUNTY
MICHIGAN

FEBRUARY 9, 2024

MCSA Group, Inc.
529 Greenwood Avenue SE
East Grand Rapids, Michigan 49506

Project No. 2023.2323

SOILS & STRUCTURES

February 9, 2024

MCSA Group, Inc.
529 Greenwood Avenue SE
East Grand Rapids, Michigan 49506

Attention: Ms. Tiffany Smith

Regarding: Pere Marquette South Restroom
Geotechnical Report
Muskegon, Muskegon County, Michigan
Project No. 2023.2323

Dear Ms. Smith:

Soils & Structures is pleased to present this geotechnical investigation report for the Pere Marquette South Restroom project located at 1651 Beach Street in Muskegon, Muskegon County, Michigan.

The investigation included two (2) test borings extended to a depth of 25.0 feet. The test borings were conducted in accordance with ASTM D 1586 procedures.

The report, test boring location plan, and test boring logs are enclosed. The report provides recommendations for site preparation, foundations, fill, floors, and pavement.

We appreciate the opportunity to provide engineering services to MCSA Group, Inc. If you have any questions regarding this report, please contact our office.

Sincerely,
Soils & Structures, Inc.

Malea G. Tanner, E.I.T.
MGT/mt

Reviewed by:

Vincent O. Oderah, P.E.

SOILS & STRUCTURES

Table of Contents

Appendix

- Test Boring Location Plans
- General Soil Profile
- Test Boring Logs
- Laboratory Tests
- General Soil Information

SOILS & STRUCTURES

Location of Soil Investigation

The soil investigation was conducted at the site located at 1651 Beach Street in Muskegon, Muskegon County, Michigan. The parcel number for the site is 61-24-205-734-0001-00.

Purpose of Investigation

The purpose of this investigation is to provide geotechnical engineering recommendations for the design and construction of the proposed beach renovations.

Design Information

The renovations will consist of a new concrete plaza with a protected edge, a new restroom building, and renovation of the existing building on site. A sheet pile wall will be constructed along the edges of the concrete plaza for protection against subgrade erosion. The new restroom building will have a footprint of approximately 633.0 square feet and is anticipated to be a single-story wood-framed structure with slab on grade floor. Pavement for the project will include the new concrete plaza.

The maximum column and wall loads are anticipated to be less than 30,000 pounds and 3,000 pounds per linear foot, respectively. Allowable settlements of 0.6 inches for total settlement and 0.4 inches for differential settlement are assumed. If the actual design is significantly different than assumed in this report, then Soils & Structures should be contacted so that the recommendations included in this report may be reviewed and revised if necessary.

The floor elevation of the building has not been determined at the time of this report but is anticipated to match the elevation of the existing building. Fill and excavation may be required to achieve the desired grade. Excavation and backfill will also be required for construction of the foundations and utilities. The greatest depth of excavation for construction of the foundations and utilities is anticipated to be less than 4.0 feet below the proposed floor elevation. Groundwater controls and dewatering will probably not be necessary.

Tests Performed

The investigation included two (2) test borings extended to a depth of 25.0 feet. The test borings are designated as Test Boring One (TB-01) and Test Boring Two (TB-02). The locations were determined by MCSA Group, Inc. Soils & Structures reviewed the locations for accessibility and revised as necessary. The test borings were conducted in accordance with ASTM D 1586 procedures. The ASTM D 1586 standard describes the procedure for sampling and testing soil using the Standard Penetration Test. An automatic hammer was used to obtain the soil samples.

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The surface elevations at the test boring locations and additional points of reference were obtained with a Global Navigation Satellite System (GNSS) Receiver. The receiver was connected to the local MDOT CORS base station. Through this system, vertical measurements are obtained and referenced to the North American Vertical Datum (NAVD88). Horizontal measurements are also obtained at the test boring locations which are referenced to the Michigan State Plane Coordinate System. Measurements of additional site-specific reference points were also obtained. Both the vertical and horizontal measurements typically have an accuracy of approximately 0.5 inches. The measured test boring locations and surface elevations can be found in Table 1.

Table 1: Measured Test Boring and Points of Reference Locations and Surface Elevations

Test Boring / Location	Elevation (feet)	Northing (feet)	Easting (feet)	Surface Cover
Test Boring One*	596.5	632543.3	12599702.9	Sand
Test Boring Two*	597.4	632470.6	12599714.2	Sand
Base Setup VRS1	649.2	626294.3	12621420.6	-

*Note: GNSS data including elevation, northing, and easting may be inaccurate due to overhead obstructions

Soil samples were classified according to the Unified Soil Classification System. This method is a standardized system for classifying soil according to its engineering properties. Please refer to the appendix of this report for the Unified Classification System Chart. The classification is shown in the "Material Description" column of the test boring logs.

The soil strength and the allowable soil bearing value were evaluated using the "N" value. The "N" value is the number of blows required to drive a soil sampler one foot with a standard 140-pound drop hammer. The sampler is driven a distance of 18.0 inches. The number of blows for each 6.0-inch increment is recorded. The sum of the second and third intervals is the "N" value. The number of blows for each 6.0-inch interval is shown on the test boring logs under the column labeled "Blow Counts". The "N" value for each sample is shown in the adjacent column.

Laboratory testing consisted of natural moisture content (ASTM D 2216) and sieve analysis (ASTM D 6913). The tests were performed on representative soil samples. The tests were performed in accordance with the ASTM standards listed above. The moisture content documents the presence of groundwater in the soil. The sieve analysis determines the particle distribution which is used to classify the soil and estimate its properties.

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The U.S. Geological Survey Topographic map and the Quaternary Geology map of Michigan were reviewed. These maps provide general geological information about the region. Publicly available well log records were reviewed to determine the depth of bedrock.

Description of Soil

The general soil profile consists of a layer of sand which extends to a depth of at least 25.0 feet. The soil profile is a deposit of dune sand. Dune sand is a rounded to subrounded, fine to medium sand composed primarily of quartz. The deposit is a dune ridge that follows the leeward shore of Lake Michigan. Dune sand is susceptible to movement from erosion.

Bedrock is present below a depth of approximately 93.0 feet. The bedrock consists of primarily sandstone and is part of the Marshall Formation. The Marshall Formation originated during the Carboniferous Period which ended approximately 298.9 million years ago.

The upper sand layer is present at the surface in the area of the test borings and consists of brown, fine to medium sand. The upper sand layer extends to a depth of 14.0 feet. The "N" values of the upper sand layer range from 2 to 7, indicating the sand is in a loose to slightly compact state. The "N" values correspond to an internal friction angle between 26 and 28 degrees.

The lower sand layer consists of light brown and brown fine to medium sand. The sand layer extends to a depth of at least 25.0 feet. The "N" values of the sand range from 13 to 59, indicating the sand is in a compact to extremely compact state. The "N" values correspond to an internal friction angle between 31 and 35 degrees.

Description of Groundwater Conditions

The water table was encountered at a depth of 20.0 feet in the test borings. The static water table will closely correspond to the elevation of Lake Michigan and is anticipated to fluctuate with seasonal precipitation. Long-term groundwater monitoring was not included as part of the report.

Description of Site

The site is located at 1651 Beach Street in Muskegon, Muskegon County, Michigan. The site is on the eastern shore of Lake Michigan and consists of a parking lot and an existing building. The proposed restroom building will be situated on the northwest side of the existing building. The site is bordered to the north, east, and south by Beach Street. Photographs #1 and #2 show the site at the time of the investigation.

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Photograph #1: North portion of the site and existing facility. View is to the south. (Project No. 2023.2323, Pere Marquette South Restroom, Muskegon, Muskegon County, Michigan, January 2024)

Photograph #2: Northwest portion of the site in the area of Test Boring One. View is to the northwest. (Project No. 2023.2323, Pere Marquette South Restroom, Muskegon, Muskegon County, Michigan, January 2024)

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Recommendations

Site & Subgrade Preparation

Trees and vegetation in the construction areas should be cleared and removed as part of subgrade preparation. Due to the presence of dune sand susceptible to movement from erosion, care should be taken to avoid unnecessary disturbance of trees and vegetation. Topsoil should be removed to the extent that all soil with an organic content of 3.0 percent or greater is removed. Soil containing roots should be removed to the extent that the root content by volume is 5.0 percent or less. All roots over 0.5 inches in diameter should be removed. The amount of topsoil anticipated to be removed is minimal.

Fill or excavation may be required to achieve the desired grade. Excavated soil may be retained for use as fill. Fill should be placed following the recommendations in the "Fill" section of this report. Fill should be compacted to 95.0 percent of the soil's maximum density to its full depth. In-situ sand should be compacted to 95.0 percent of its maximum density prior to the placement of fill.

The subgrade below the pavement and building should be proof rolled prior to construction. The proof roll should consist of single, overlapping passes. Areas that experience yielding during the proof roll should be recompacted. If these areas still experience yielding following compaction, undercutting or the use of geogrid may be required to stabilize the subgrade.

Soil brought to the site for fill should be clean sand and gravel meeting MDOT specifications. The soil which will be used for fill should be kept free of topsoil and other organic materials. Compaction tests are recommended to check the compaction of the new fill.

Foundations

Spread foundations are recommended to support the building provided the subgrade is prepared as discussed in this section as well as the "Site & Subgrade Preparation" and "Fill" sections of this report including compaction. The foundations are anticipated to be supported on the in-situ sand or compacted fill following site preparation.

Fill below the new building should be compacted to a density of 95.0 percent of the soil's maximum density to its full depth. In-situ sand should be compacted to 95.0 percent of the sand's maximum density to a minimum depth of 4.0 feet below the foundations. Compaction tests should be performed in the foundation subgrade to verify these levels of compaction. Soils not exceeding the minimum density should be recompacted.

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The recommended minimum cover over the bottom of exterior foundations is 42 inches for protection against frost heave. Foundations should not be constructed on frozen soil. During cold weather construction, the foundation subgrade and foundations should be protected from freezing with insulated blankets until backfill is placed over both sides of the foundation. Foundations that are damaged by frost heave should be replaced.

The site classification for seismic design is "D" based on ASCE-7 Table 20.3-1 and the Michigan Building Code. The site has a peak ground acceleration of 0.076g with a 2.0 percent probability of exceedance in 50 years. The final seismic parameters including the seismic design category of the structure should be verified by the structural engineer on record.

Foundations may be designed using an allowable bearing value of 2,500 pounds per square foot for column footings and 2,000 pounds per square foot for wall foundations provided the recommendations for subgrade preparation in the previous section are followed. A minimum width of 16.0 inches is recommended for new foundations. The allowable bearing values may be increased by 25.0 percent when considering transient loads such as earthquakes and wind.

Settlement

The maximum settlement of the building is anticipated to be less than 0.3 inches provided the recommendations in this report are observed including compaction. Differential settlement will be approximately one half of the maximum value. These levels of settlement are within the recommended acceptable limits of 0.6 inches of total settlement and 0.4 inches of differential settlement.

Floors

A slab on grade is recommended for the floors. A modulus of subgrade reaction of 150 pounds per cubic inch is recommended for the design of slabs on grade.

A base of 6.0 inches of clean sand is recommended under the floors. The sand should meet MDOT Class II specifications. Fill under floors should be compacted as specified in the "Fill" section of this report. The in-situ sand is suitable for use as a base material.

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Lateral Earth Pressure

Foundation walls with different soil levels on either side should be designed as retaining walls. Sand should be used as backfill behind retaining and foundation walls. The sand should meet MDOT Class II specifications. The walls should be designed using a soil density of 120 pounds per cubic foot, a coefficient of active earth pressure of 0.35 for level sand backfill and a coefficient of at rest earth pressure of 0.50. The effects of any surcharge or sloping backfill should also be included in the design. The passive resistance of the existing sand should be calculated using an earth pressure coefficient of 2.7.

Excavations

The in-situ sand is an OSHA type "C" soil. Excavations that will be entered by personnel should be based on OSHA requirements for a type "C" soil. Based on OSHA requirements, a maximum allowable side slope of 34 degrees (1.5H:1V) is recommended for excavations 4.0 to 20.0 feet deep. Excavations less than 4.0 feet deep may have vertical side slopes. Excavations adjacent to structures or property lines may require temporary shoring.

Care should be taken to avoid undermining the existing foundations and floor during construction of new foundations. Temporary shoring may be required during excavation for new foundations and should be designed based on the recommendations in the previous section.

Fill

Fill should be compacted to a density of 95.0 percent of its maximum density. The maximum density should be determined in accordance with the ASTM D 1557 standard. A maximum thickness per lift of 6.0 inches is recommended. The lift thickness may be increased to 12.0 inches if a vibratory roller or hoe-pack is used for compaction. Compaction tests are recommended to confirm that the fill is compacted to the required density.

Soil brought to the site for structural fill should be sand meeting MDOT Class II requirements or ASTM requirements for a SP or SW which are the designations for clean sand. Excavated sand may be used as structural fill. If the amount of fill required to establish the final grade exceeds the amount of material available on site, additional material will have to be imported.

Fill should not be placed over frozen ground, snow or ice. Soil which contains frozen material should not be used as fill. During winter construction, removal of frozen ground may be necessary prior to placing fill.

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Groundwater Management

Dewatering will probably not be necessary for construction of the foundations. Groundwater will probably not be encountered in excavations. If groundwater is encountered in excavations for utilities and foundations, the excavation bottom may be stabilized by placing a 6.0 to 8.0-inch layer of porous aggregate over the bottom of the excavation. The aggregate will stabilize the bottom of the excavation.

A vapor barrier is recommended under the floor in areas that will be enclosed and heated. The vapor barrier should consist of a 10-mil polyethylene sheet and should be located immediately below the floor slab. The vapor barrier may be omitted in portions of the building that will not be heated.

Water appears to infiltrate through the sand at an acceptable rate for internal drainage of the site. Stormwater will only infiltrate to the elevation of Lake Michigan.

Drains around the foundation may be omitted. The in-situ sand meets the exception in Section 1805.4 of the Michigan Building Code to the requirements for drains. If required, drains should consist of a 4.0-inch diameter slotted plastic pipe wrapped in filter fabric. Pea gravel should be used for backfill within a 6.0-inch circumference of the drain.

Pavement areas should be properly drained to minimize the effects of frost heaving and the loss of subgrade due to water infiltration.

Portland Cement Concrete (PCC) Pavement

The subgrade should be prepared in accordance with the "Site & Subgrade Preparation" and "Fill" sections of this report.

A base of 12.0 inches of clean sand or aggregate is recommended under the slab on grade concrete pavement. The base thickness may be reduced to 6.0 inches for sidewalk slabs. The sand or aggregate should meet MDOT Class II or 21AA specifications respectively. The in-situ soil is suitable for use as a base material. A minimum slab on grade concrete pavement thickness of 4.0 to 6.0 inches is recommended for standard and heavy-duty concrete pavement. The recommended minimum concrete pavement thickness is 4.0 inches for sidewalks surrounded by greenbelt and 5.0 inches for revealed-face slabs.

A modulus of subgrade reaction of 150 pounds per cubic inch is recommended for the design of slabs on grade, provided the recommendations in this report are observed. The paving contractor should submit the proposed mix design to the owner for review and approval prior to concrete placement.

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Quality Control Testing

Compaction tests (ASTM D 6938) are recommended to confirm that sand and fill in the construction areas are compacted to the specified density. While fill is being placed, compaction tests should be performed at the rate of one test per 400 cubic yards of fill and throughout the depth of the fill with a minimum of five tests at each 1.0-foot elevation interval. Full time inspection is recommended while sand and fill are compacted in the building areas. Compaction tests should be performed under foundations at the rate of one test per 50 linear feet for wall foundations and one test per column foundation. The recommended testing frequency in the floor and pavement subgrade is one test per 2,500 square feet. Tests should also be performed in the backfill over foundations and utilities. The maximum density should be determined in accordance with ASTM D 1557 or ASTM D 4253 procedures.

Unless otherwise specified in the design documents or project plans, the following testing procedures and frequencies should be observed for slab on grade concrete floors. Concrete quality testing should adhere to the 2020 MDOT Standards for Construction.

Concrete testing should be performed by a certified concrete technician (MCA Michigan Level I or II). One set of concrete tests should be performed for every fifty (50) cubic yards of concrete placed. Concrete should be sampled in accordance with ASTM C172. A set of concrete tests should consist of a concrete slump, air content, and concrete temperature. Slump testing should be performed in accordance with ASTM C143. Air content testing should be performed in accordance with ASTM C231. Concrete temperature testing should be performed in accordance with ASTM C1064. Air temperature should also be recorded at the time of testing. At the time of testing, a set of test cylinders should be molded as well. A minimum of two (2) test cylinders should be molded per cylinder set for 28-day compressive strength testing. Test cylinders should be prepared in accordance with ASTM C31 and tested in accordance with ASTM C39.

A smooth 0.5 to 0.75-inch diameter rod should be used in conjunction with compaction tests to probe for loose areas under foundations, in fill, and under floors. A dynamic cone should not be substituted for compaction tests for evaluating fill. Testing should be performed by technicians supervised by a registered geotechnical engineer.

General Conditions & Reliance

The report was prepared in accordance with generally accepted practices of the geotechnical engineering profession. The scope of work consisted of performing two (2) test borings and providing soil related recommendations for the design and construction of the proposed beach renovations. The scope of work did not include an environmental study or wetland determination.

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The report and the associated test borings were prepared specifically for the previously described project and site. Soils & Structures should be consulted if a significant change in the scope of the project is made.

The test borings represent point information and may not have encountered all of the soil types and materials present on this site. This report does not constitute a guarantee of the soil or groundwater conditions or that the test borings are an exact representation of the soil or groundwater conditions at all points on this site.

The descriptions and recommendations contained in this report are based on an interpretation of the test borings and laboratory tests. The test borings should not be used independently of the report. If soil conditions are encountered which are significantly different from the test borings, Soils & Structures should be consulted for additional recommendations.

The report and test borings may be relied upon for the design, construction, permitting, and financing associated with the Pere Marquette South Restroom project located at 1651 Beach Street in Muskegon, Muskegon County, Michigan. The use of the report and test borings by third parties not associated with this project or for other sites has not been agreed upon by Soils & Structures. Soils & Structures does not recommend or consent to third party use or reliance of the report or test borings unless allowed to review the proposed use of these materials. Unless obtained in writing, consent to third party use should not be assumed. Third parties using the report or test boring logs do so at their own risk and are offered no guarantee or promise of indemnity.

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SOILS & STRUCTURES

Appendix

Test Boring Location Plans
General Soil Profile
Test Boring Logs
Laboratory Tests
General Soil Information

VICINITY MAP (NTS)

TEST BORING LOCATION PLAN

NTS

Note: The background of the test boring plan is a portion of an aerial photograph from Google Earth.

Pere Marquette South Restroom

Muskegon, Muskegon County, Michigan

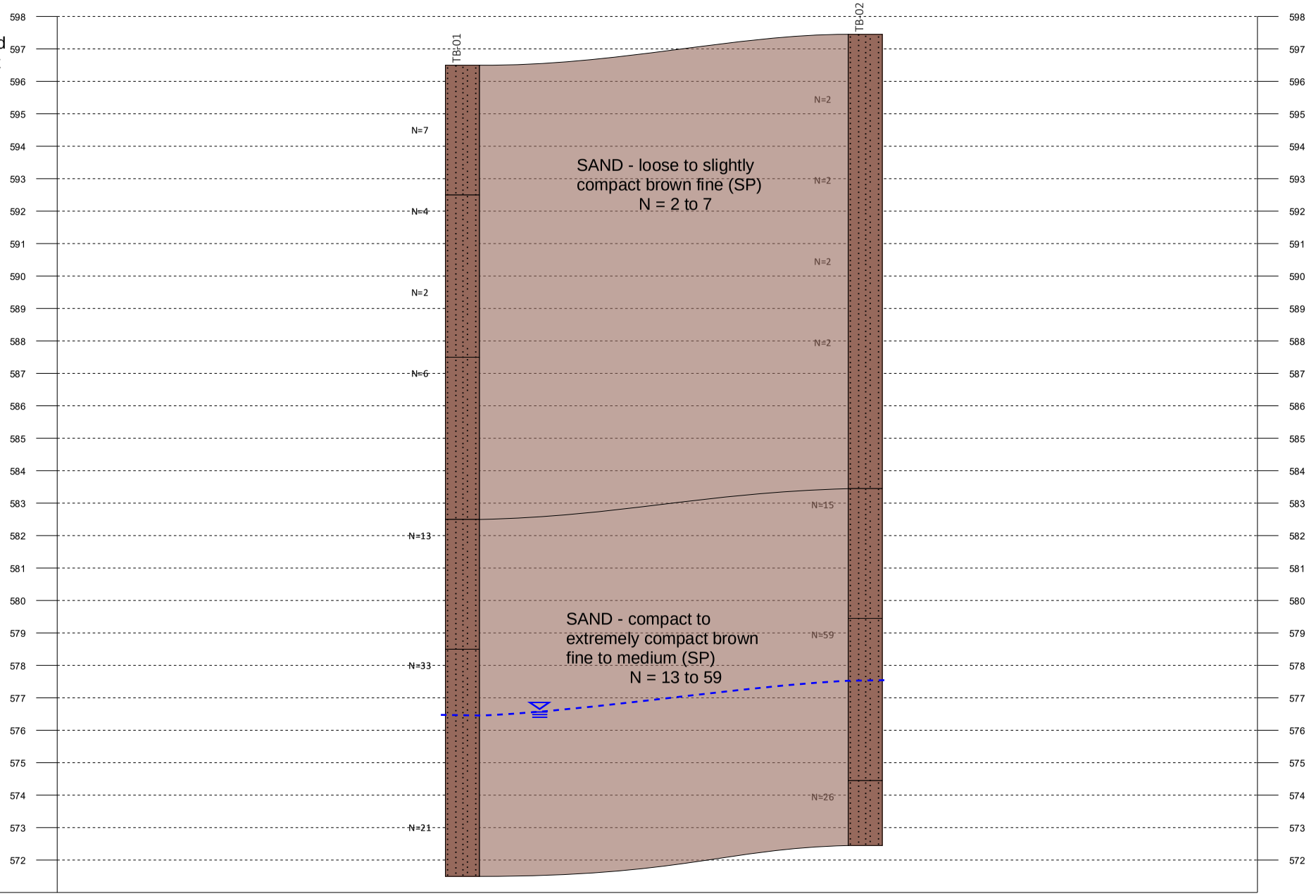
Soils & Structures, Inc.
6480 Grand Haven Road
Muskegon, Michigan 49441

JOB NO.: 2023.2323 DATE: 02-02-2024

Project Id:	2023.2323	Title:	Section line 1
Project Title:	Pere Marquette South Restroom	Vertical Scale:	1:50
Location:	Muskegon, Michigan	Horizontal Scale:	1:417
Client:	MCSA Group, Inc	Engineer:	Malea Tanner, EIT

GENERAL SOIL PROFILE

NOTE: The water table was encountered at a depth of 20.0 feet in the test borings.



Legend Key

Poorly Graded SAND

SOILS & STRUCTURES

Borehole ID: TB-01

Sheet 1 of 1

Project Name: Pere Marquette South Restroom
Project Number: 2023.2323
Project Location: Muskegon, Michigan
Logged By: H Spangler
Reviewed By: K Martella
Client: MCSA Group, Inc
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 25.00
Date Started: Jan 30 2024
Completed: Jan 30 2024
Northing: 632543.3
Easting: 12599702.9
Elevation: 596.50
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-50
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 20.00' on Jan 30 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1		SAND - slightly compact brown fine												
2														
3			SPT	SPT-A	87	4-2-5	7			4.9				SP
4		SAND - loose brown fine to medium												
5			SPT	SPT-B	87	1-1-3	4							SP
6														
7			SPT	SPT-C	87	1-1-1	2			7.1				SP
8														
9		SAND - slightly compact brown fine												
10			SPT	SPT-D	87	1-2-4	6							SP
11														
12														
13														
14		SAND - compact light brown fine												
15			SPT	SPT-E	87	2-6-7	13			2.4				SP
16														
17														
18		SAND - very compact brown fine												
19			SPT	SPT-F	87	6-12-21	33							SP
20														
21														
22														
23														
24			SPT	SPT-G	87	5-8-13	21			24.8				SP
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Borehole ID: TB-02

Sheet 1 of 1

Project Name: Pere Marquette South Restroom
Project Number: 2023.2323
Project Location: Muskegon, Michigan
Logged By: H Spangler
Reviewed By: K Martella
Client: MCSA Group, Inc
Survey Datum: NAD 1983 StatePlane Michigan South
Hole Depth: 25.00
Date Started: Jan 30 2024
Completed: Jan 30 2024
Northing: 632470.6
Easting: 12599714.2
Elevation: 597.45
Drilling Method: 3-1/4" Hollow Stem Auger
Frost Depth
Equipment: Diedrich D-50
Ground Water Levels
Hammer Type: Automatic Hammer
Notes:
End of Drilling 20.00' on Jan 30 2024

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	USCS
1		SAND - loose brown fine												
2														
3				SPT-A	87	1-1-1	2							SP
4														
5				SPT-B	67	1-1-1	2			4.1				SP
6														
7				SPT-C	67	1-1-1	2							SP
8														
9														
10				SPT-D	87	1-1-1	2			5.4				SP
11														
12														
13														
14		SAND - compact light brown fine												
15				SPT-E	87	6-6-9	15							SP
16														
17														
18		SAND - extremely compact brown fine to												
19		medium with a trace of silt		SPT-F	87	12-24-35	59			18.9				SP
20														
21														
22														
23		SAND - very compact brown fine												
24				SPT-G	67	9-12-14	26			20.5				SP
25														
26														
27														
28														
29														
30														

SOILS & STRUCTURES

Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name	Pere Marquette South Restroom
Project Number	2023.2323
Client	MCSA Group, Inc
Date	2/8/2024

Sample Location		TB-01	TB-02	TB-01	TB-02	TB-01
Sample ID		A	B	C	D	E
Depth	ft	2.0	4.5	7.0	9.5	14.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.52	10.70	385.10	10.50	10.53
Mass of Wet Soil and Container	g	71.65	71.16	666.40	71.56	71.26
Accepted Dry mass + container	g	68.80	68.76	647.80	68.45	69.82
Water Content	%	4.9	4.1	7.1	5.4	2.4
Remarks						

Sample Location		TB-02	TB-02	TB-01		
Sample ID		F	G	G		
Depth	ft	18.5	23.5	23.5		
Sample Type		SPT	SPT	SPT		
Mass of Container	g	360.20	10.48	10.55		
Mass of Wet Soil and Container	g	669.70	71.69	71.55		
Accepted Dry mass + container	g	620.50	61.26	59.42		
Water Content	%	18.9	20.5	24.8		
Remarks						

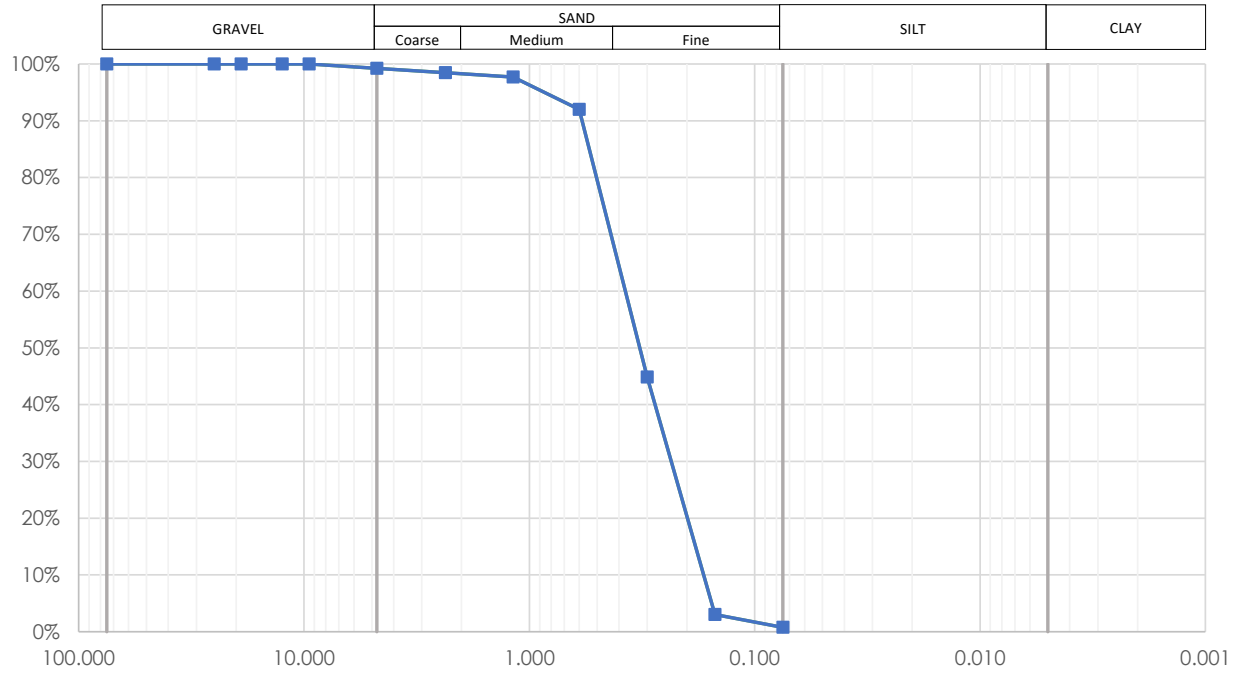
Sample Location						
Sample ID						
Depth	ft					
Sample Type						
Mass of Container	g					
Mass of Wet Soil and Container	g					
Accepted Dry mass + container	g					
Water Content	%					
Remarks						

Technician	Checked	Approved
kmartella	mvanweelden	mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Pere Marquette South Restroom				
Project Number	2023.2323				
Client	MCSA Group, Inc				
Date	2/8/2024				
Sample Location	TB-01	Sample ID	C	Depth (ft)	7.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	0.8%	1.0%	33.7%	63.8%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
0.5554	0.3963	0.3327	0.2467	0.1929	0.1750	0.8%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	100%
No. 4	99%
No. 8	98%
No. 16	98%
No. 30	92%
No. 50	45%
No. 100	3%
No. 200	0.8%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium SAND (SP)

Remarks

Technician

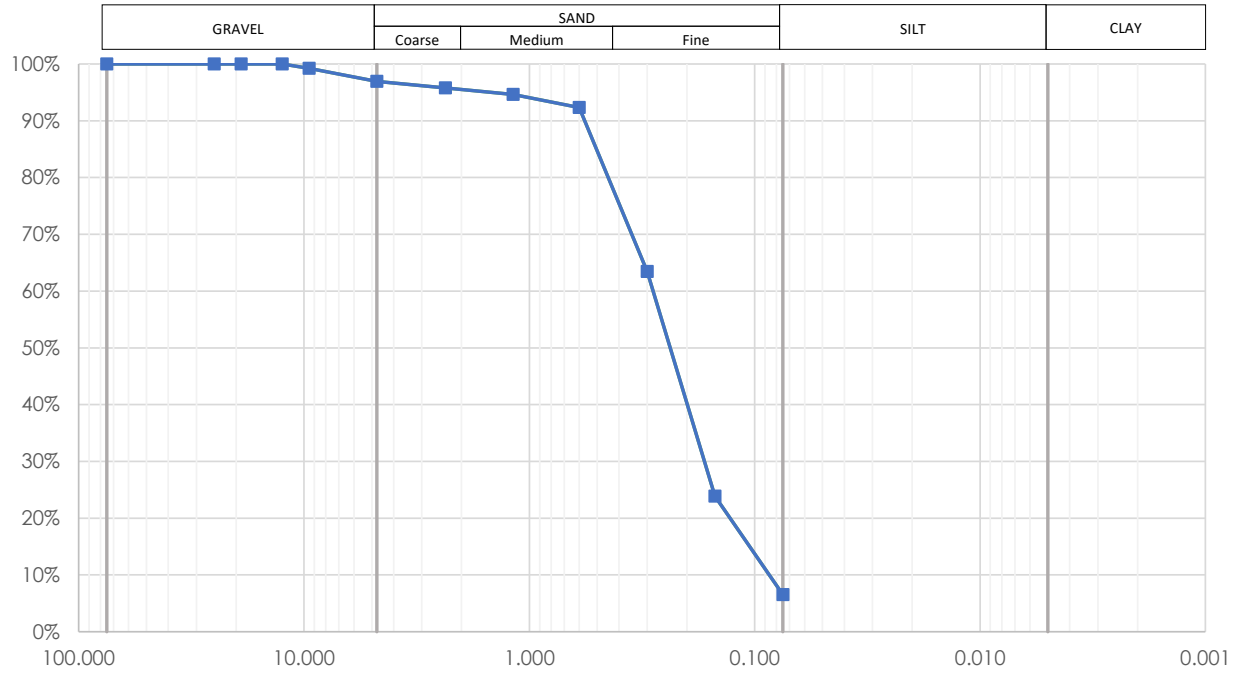
Checked
mvanweelden

Approved
mvanweelden

SOILS & STRUCTURES

Particle Size Distribution Report

Project Name	Pere Marquette South Restroom				
Project Number	2023.2323				
Client	MCSA Group, Inc				
Date	2/8/2024				
Sample Location	TB-02	Sample ID	F	Depth (ft)	18.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	3.1%	1.5%	19.9%	68.9%	0.0%	0.0%
D85	**D60**	**D50**	**D30**	**D15**	**D10**	**Loss By Wash**	
0.5240	0.2869	0.2490	0.1733	0.1117	0.0900	6.5%	

Particle Size	
Sieve	**% Passing**
3 in.	100%
1 in.	100%
3/4 in.	100%
1/2 in.	100%
3/8 in.	99%
No. 4	97%
No. 8	96%
No. 16	95%
No. 30	92%
No. 50	63%
No. 100	24%
No. 200	6.5%

Hydrometer	
Particle Size (mm)	**% Passing**

Material Description
Fine to Medium SAND with a Trace of Silt (SP)

Remarks

Technician

Checked
mvanweelden

Approved
mvanweelden

SOILS & STRUCTURES

General Information for Method of Field Investigation

The soil investigation was performed in accordance with the American Society of Testing and Materials method ASTM D 1586, which is the "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". Samples of compressible clays or organic soils are obtained in accordance with ASTM D 1587, which is the "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes." Rock may be cored in conjunction with the above methods as specified in ASTM D 2113 which is the "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation."

Field Testing

Standard Penetration Tests (SPT) in accordance with ASTM D 1586 were generally performed at depths of 2.0', 4.5', 7.0', 9.5' and 5.0' intervals thereafter.

Laboratory Testing

Samples obtained from the Standard Penetration Test, ASTM D 1586 or thin walled tube method, ASTM D 1587, were tested in the laboratory for the moisture content and density and/or particle size, where applicable. When soils sampled possessed sufficient cohesive properties, it was tested for its compressive strength in the unconfined state.

Natural Percent Moisture content (N.P.M.) of the soil is the percentage by weight of water contained in the soil sample compared to the dry weight of the solids of which the soil is composed. The NPM of select samples is determined in accordance with ASTM D 2216.

Natural Density (N.D.) of soil as reported on the appended boring logs is the natural wet density of the soils expressed in pounds per cubic foot.

The unconfined compressive strength of cohesive soils is determined in the laboratory on "undisturbed" select samples in accordance with ASTM D 2166. This test determines the maximum load required at a specified rate to deform the cohesive soil specimen length twenty (20%) percent. The primary purpose of the unconfined compression test is to obtain approximate quantitative values of the compressive strength of soils possessing sufficient coherence to permit testing in the unconfined state. The shear strength of the cohesive soil can be calculated from the results of the unconfined compressive strength test.

Color

When the color of the soils is uniform throughout, the color recorded will be such as brown, gray, and black and may be modified by adjectives such as light and dark. If the soils predominant color is shaded by secondary color, the secondary color precedes the primary color, such as gray-brown, or yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled; such as mottled brown and gray.

Water Observations

Depth of water recorded in the test boring is measured from the ground surface to the water surface. Initial depth indicates water level during boring, completing depth indicates water level immediately after boring, and depth after "X" number of hours indicates water level after allowing the groundwater rise or fall over a period of time. Water observations in pervious soils are considered reliable groundwater levels for accurate groundwater measurements at the time the test borings were performed unless records are made over several days' time. Factors such as weather, soils porosity, etc., will cause the groundwater level to fluctuate for both pervious and impervious soils.

SOILS & STRUCTURES

Sample Type

If not otherwise indicated, the sample is a split-barrel liner sample ASTM D 1586.

"S.T.' – Shelby tube sample, ASTM D 1587
"A" – disturbed augered sample
"C" – rock core sampled ASTM D 2113
N.P.M. – Natural Percent Moisture of in-situ soils sample
N.D. – Natural Density of in-situ soils sample in pcf.
S.S. – Shear Strength of cohesive soils samples as determined by the Unconfined Compression tests in ksf.

Classification Data – Laboratory data to assist in classification of soils and classification of soils characteristics; i.e., plastic limit or liquid limit

Test Boring Logs

Particle Size	**Visual**
Boulders	Larger than 12" (300 mm)
Cobbles	12" to 3" (300 to 75 mm)
Gravel - Coarse	3" to ¾ " (75 to 19 mm)
Gravel – Fine	19.0 to 4.75 mm
Sand- Coarse	4.75 to 2.0 mm
Sand - Medium	2.0 to 0.425 mm
Sand - Fine	0.425 to 0.075 mm
Silt	0.075 to 0.002 mm
Clay	0.002 mm and smaller

Soils Components

Major Component	**Minor Component**
Gravel	Trace (1 - 10%)
Sand	Some (11 - 35%)
Silt/Clay	And (36 - 50%)

Condition of Soil Relative to Compactness

Granular Material	**"N" Value**
Loose	0 - 4
Slightly Compact	5 - 7
Compact	8 - 20
Very Compact	21 - 50
Extremely Compact	51 and above

Cohesive Material	**"N" Value**
Soft	0 - 4
Firm	5 - 7
Stiff	8 - 20
Very Stiff	21 - 50
Extremely Stiff	51 and above

"N" values in clay soils are not to be used as a measure of shear strength. However, they may be used as a general indication of strength.

SOILS & STRUCTURES

Unified Soil Classification System Chart

Major Divisions			Letter Symbol	Typical Descriptions
Coarse Grained Soils More than 50% of material is larger than No. 200 sieve size	Gravel – Gravelly Soils more than 50% of coarse fraction retained on No. 4 sieve	Clean gravels (little or no fines)	GW	Well-Graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
		Gravel with Fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction passing No. 4 sieve	Clean Sand (little or no fines)	SW	Well-Graded sands, gravelly sands, little or no fines
			SP	Poorly-Graded sands, gravelly sands, little or no fines
		Sand with Fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine Grained Soils More than 50% of material is smaller than No. 200 sieve size	Silts and Clays Liquid limit less than 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays or low plasticity
	Silts and Clays Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays or medium to high plasticity, organic silts
	Highly organic soils		PT	Peat, humus, swamp soils with high organic contents

For Laboratory Classification of Fine Grained Soil
Plasticity Chart