



State of Michigan
Department of Technology, Management and Budget
State Facilities Administration
Design and Construction Division

50K SPEC
Bidding and Contract Document
Minor Projects

File No.: 751/23403.CTS
Department of Natural Resources
Hartwick Pines State Park
Effluent Flowmeter Vault Installation

May 1, 2026

BID SUMMARY
DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET

STATE FACILITIES ADMINISTRATION
DESIGN AND CONSTRUCTION DIVISION
3111 W. St. Joseph Street
Lansing, Michigan 48917

Bids must be submitted electronically through the SIGMA website at
<https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>

FILE NUMBER 751/23403.CTS	FUNDING CODE N/A	DEPARTMENT/AGENCY Department of Natural Resources	
CONTRACT TIME(S) Substantial Completion date 30 Days after Notice of Award. (Duration or deadline)	PROJECT NAME Hartwick Pines State Park Effluent Flowmeter Vault Installation	LOCATION Hartwick Pines State Park, Day Use Area and Visitors Center #2	
BID OPENING DATE May 20, 2026 at 2:00 pm ET		FOR AN EXAMINATION OF THE SITE CONTACT: Mike Signorello Phone: 989.348.5293	
SEE SECTION 00100 INSTRUCTIONS TO BIDDERS AND SECTION 00700 GENERAL CONDITIONS PROVIDED WITH THE BIDDING DOCUMENTS. BID: WE PROPOSE TO FURNISH, PERFORM AND COMPLETE THE ENTIRE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS IN CONSIDERATION OF THE BID PRICE (S) STATED BELOW.			
FIRM NAME AND COMPLETE ADDRESS		TELEPHONE NUMBER and E-MAIL ADDRESS	
<input type="checkbox"/> Qualified Disabled Veteran		SIGMA VENDOR NUMBER	
BIDDER'S SIGNATURE AND TITLE		(protected information required for processing payments)	
DATE	WITNESS' SIGNATURE	DATE	

By signing this bid above, bidder certifies their enclosed Qualified Disabled Veteran and Michigan-Based Business Certifications.

*Protected information required for processing payments.

Base Bid (from Bid Schedule) (Include specified Allowance):Dollars \$ _____

BID GUARANTEE REQUIRED: A FIVE (5) PERCENT BID SECURITY IS REQUIRED FOR ALL BIDS. BUILDERS RISK INSURANCE IS REQUIRED TO BE PROVIDED BY THE CONTRACTOR UNLESS OTHERWISE INDICATED IN THE BID DOCUMENTS A PERFORMANCE BOND AND A PAYMENT BOND IS REQUIRED ON ALL BIDS OVER \$50,000.00.

NOTE: BIDDERS ARE CAUTIONED TO FAMILIARIZE THEMSELVES WITH ALL OF THE CONDITIONS OF THE CONTRACT AS SET FORTH THROUGHOUT THE BIDDING AND CONTRACT DOCUMENTS.

Project Scope of Work:

Installation of new effluent magnetic flowmeters and concrete vaults at the Day Use Area and Visitors Center #2 sites at Hartwick Pines State Park. Includes furnishing and installing magnetic flowmeter and digital readouts, concrete vaults with castings and lids and all associated restoration.

The Bidder must figure its Base Bid on the specified, or Addendum-approved, materials and equipment **only**. No "or equal" or substitution proposals will be permitted after Bid opening, except as provided in the General Conditions.

Contract Time(s): Work to be Substantially Complete 30 days after Notice of Award.

Addenda: Bidder acknowledges receipt of Addenda: No. ___ dated: _____, No. ___ dated: _____ No. ___ dated: _____

This Bid Summary is intended to serve as a summary page. Failure to complete this Bid Summary may be cause for the Bid to be rejected.

BID SCHEDULE

Base Bid Schedule – The Bidder will complete the Work and accept as full payment, for the Work items listed, the following Unit Prices and/or Item Bid Prices as applicable:

Base Bid Item No.	Bid Quantity	Description	Unit Price	Item Bid Price
01	1 LSUM	Furnish and Install Flowmeter and Vault (Day Use Area)		
02	1 LSUM	Furnish and Install Flowmeter and Vault (Visitors Center #2)		
03		ALLOWANCE AMOUNT		\$10,000
TOTAL (This amount should equal the Base Bid amount on the Bid Summary Form)				\$

Schedule of Alternates – The bidder will complete (or deduct from the Contract) the parts of the Work designated by the Alternates that follow and accept in full payment (or in full credit) for those parts of the Work the following Item Bid Prices:

Alternate Item No.	Bid Quantity	Description	Unit Price	Item Bid Price
N/A				

The Bidder further acknowledges and agrees that the separate prices bid on this "Schedule of Alternates," where they are applicable and deemed acceptable by the **Owner** issues the Notice of Award.

Name of Bidder: _____

SIGMA VENDOR NUMBER.: _____

Date: _____

INSTRUCTIONS TO BIDDERS

1. PRE-BID INFORMATION

1.1 Invitation to Bid (ITB) – Bids must be submitted electronically through the SIGMA website at <https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>. The State reserves the right to cancel this Invitation to Bid (ITB) or change the date and time for submitting Bids by announcing same at any time before the established date and time for Bid opening. Bids must remain open for acceptance by the Owner for no less than the Bid hold period. Contractor may agree to extend the Bid hold period. However, any such extension must be based upon no increase in the Bid Price and/or Contract Time.

1.2 Work Description – The Work, Effluent Flowmeter and Vault Installation, Agency No. 751, DTMB File No. 23403.CTS, includes, but is not necessarily limited to:

Installation of new effluent flowmeters, concrete vaults, electrical conduit and wiring, electrical components, and associated restoration at the Day Use Area and Visitors Center #2.

The site is located at Hartwick Pines State Park Day Use Area and Visitors Center #2, as shown on the Drawings.

1.3 Bid Security – Each Bid must enclose a duly executed Bid Security, in the amount of five percent (5%) of the Bidder's Base Bid, paid to the "State of Michigan" in the form of a certified or cashier's check or money order drawn upon a bank insured by an agency of the Federal Government, or a bid bond signed by both the Bidder and the authorized surety company. If Bid Security is by check or money order, such certified or cashier's check or money order must be delivered in original copy before the Bid Due Time to:

State Facilities Administration
Design & Construction Division
3111 W. St. Joseph Street
Lansing, Michigan 48917

All other Bid information must be submitted via SIGMA as per standard bidding procedure.

1.4 Pre-Bid Conference – A mandatory voluntary pre-bid conference will be held at Hartwick Pines State Park campground entrance (Visitors Center #2 site), MI on May 14, 2026 at 11:00 AM ET. All prospective Bidders are required encouraged to attend the tour, if held. Other parties interested in the Work are encouraged to attend the tour. Addenda may be issued, in response to issues raised at the pre-bid conference and tour, or as the Owner and/or Professional may otherwise consider necessary.

1.4 Contact Person – All requests or inquiries concerning the Bidding Documents, or the Work must be addressed to PSC: Wade Trim, Inc. attn: Quinn Ridley, PE.

2. PREPARATION OF BID: Execute Bid fully and properly. Bid Summary Form and Bid Form Attachments must be used and completely filled out for the Bid to be considered responsive and meeting the requirements of the contract solicitation. All Bid prices must be printed or typed in both words and figures.

BID CONTENTS: Bid Form and Bid Form Attachments must be used, completely filled out, and signed with an authorized signature to be a valid Bid. All Bid prices must be printed or typed in both words and figures. The Bid will consist of the following forms:

Bids

All

Forms to be submitted

Signed Bid Summary Form
Bid Schedule
Signed Professional Contractor Demographics, Statistics and Certification Form
Signed Certification Regarding Debarment, Suspension, and Other Responsibility Matters Form
Bid Security in the amount of 5% of Base Bid Price
Signature Authorization as noted below
Other Forms (Professional/Agency to list the additional forms here)

3. SIGNATURES: All bids, notifications, claims, and statements must be signed as follows:

- (a) **Corporations:** Signature of official shall be accompanied by a certified copy of the resolution of the Board of Directors authorizing the individual signing to bind the corporation.
- (b) **Partnerships:** Signature of one (1) partner shall be accompanied by a certified copy of the power of attorney authorizing the individual signing to bind all partners. If bid is signed by all partners, no authorization is required.
- (c) **Individual:** No authorization is needed. Each signature must be witnessed.

4. BID PRICES: The Bidder's Base Bid and Alternate Bid prices must include, and assure payment for completed Work and will compensate in full for all services, obligations, responsibilities, management, supervision, labor, materials, devices, equipment, construction equipment, general conditions, permits, patent fees and royalties, testing, inspection and approval responsibilities, warranties, temporary facilities, small tools, supplies, insurance, taxes, mobilization, close-out, overhead and profit and all connections, appurtenances and any other incidental items of any kind or nature, as are necessary to complete the Work, in a neat,

first quality, workmanlike and satisfactory manner in accordance with the Drawings and Specifications and as otherwise required to fulfill the requirements of the Bidding Documents.

5. **INSPECTION OF BIDDING DOCUMENTS AND SITE CONDITIONS:** The Bidder must carefully review and inspect all bidding documents, site conditions, all applicable statutes, regulations, ordinances and resolutions addressing or relating to the goods and services under this contract. Failure to do so or failure to acquire clarifications and answers to any discovered conflicts, ambiguities, errors or omissions in the Bidding Documents will be at the Bidder's sole risk.
6. **SAFETY REQUIREMENTS AND LAWS:** The Bidder awarded the Contract must comply with all applicable federal, state, and local Laws including health and safety regulations, environmental protection, permits and licensing.
7. **INTERPRETATIONS AND ALTERATIONS TO THE BID AND BIDDING DOCUMENTS:** All requests for clarification or interpretation of the Bidding Documents, all proposals for any modifications to the Bidding Documents, all requests for information and all other questions or inquiries about the Bidding Documents and/or the Work shall be submitted **in writing** to the PSC Contact Person identified in the Bid Documents. Requests or inquiries received less than seven Calendar Days before the date of Bid opening will be answered only if (a) the response can be given through Addenda made available at least seventy-two hours before Bid opening (counting Business Days only), (b) the Bid opening is postponed by Addendum, or (c) the Work is rebid without re-advertising following the issuance of post-Bid Addenda. Any addition, limitation or provision made with or attached to the Bid may render it non-responsive and/or irregular and be a cause for rejection. The Owner reserves the right to issue post-Bid Addenda after opening the Bids and set a new date for the receipt and opening of sealed Bids.
8. **MODIFICATION OF RECEIVED BID:** The entire bid must be resubmitted on the SIGMA website.
9. **REJECTION OR WITHDRAWAL:** The State reserves the right to reject any bids and to waive any informality, defects, or irregularity in bids. Bids may not be withdrawn within sixty (60) calendar days after opening date. The sole liability of any bid error or mistake rests with the bidder.
10. **SIGMA VENDOR NUMBER:** If you are bidding a State job for the first time, visit the State of Michigan SIGMA website, <https://sigma.michigan.gov/webapp/PRDVSS2X1/AltSelfService>, and follow the "SOM VSS User Guide for New Vendors" instructions, located under Forms and Reference Documents. Registration is required for bid submission. **Do not wait until the last minute to submit a proposal**, as the SIGMA system requires the creation of an account and entry of certain information, in addition to uploading and submitting the materials. The SIGMA system **will not** allow a proposal to be submitted after the proposal deadline, even if a portion of the proposal has been updated.

Questions on how to submit information or how to navigate in the SIGMA VSS system can be answered by calling **(517) 373-4111 or (888) 734-9749**.
11. **MATERIALS AND EQUIPMENT:** Any Bidder wishing to use manufacturers or materials other than those specified must submit a written request to the PSC not later than seven days before due date for Bids. Request must be accompanied by product data to permit evaluation and comparison with specified products or materials. The Bidder submitting the request will be responsible for its prompt delivery. The PSC and the Owner will examine and evaluate the product data and if found acceptable, an Addendum will be issued and posted on the State's bid system website. All Addenda issued will become part of the Contract. Contractor will be responsible for any extra work and expense incurred to satisfactorily and completely incorporating each substitute product into the Project.
12. **MICHIGAN PRODUCTS AND RECYCLED PRODUCTS:** All Contractors and Suppliers are encouraged to provide Michigan-made products and/or recycled products and/or green products and/or environmentally friendly products whenever possible where price, quality, and performance are equal to, or superior to, non-Michigan products and the requirements of the Contract Documents. The Contractor will be required to use alternatives to landfills for waste disposal such as reuse or recycle of asphalt, bricks, concrete, masonry, plastics, paint, glass, carpet, metals, wood, drywall, insulation, and any other waste materials to the extent practical.
13. **QUALIFIED DISABLED VETERANS (QDV) PREFERENCE:** Each bid requesting the Qualified Disabled Veterans (QDV) preference, in accordance with Public Act 22 of 2010, MCL 18.1241(3), shall include a DD 214 Proof of Service and Discharge, a Veterans Administration rating decision letter, proof of disability (if the disability is not indicated on the DD 214), and appropriate legal documents setting forth the 51% natural persons QDV ownership. The Contractor will be required to submit applicable bonds and insurance. Upon acceptance by the State, this document will constitute the Contract and the executed duplicate will be returned to the Contractor. The Contract, however, is not in force until the Contractor has complied with all the requirements of insurance and bonds.

GENERAL CONDITIONS

ARTICLE 1 - Definitions/Glossary:

Addenda – Written instruments that are used by the Owner and/or PSC to incorporate interpretations or clarifications, modifications, and other information into the Bidding Documents. An Addendum issued after Bid opening to those Bidders who submitted a Bid, for the purpose of re-bidding the Work without re-advertising, is referred to as a post-Bid Addendum.

Alternate – Refers to work specified in the Bidding Documents, separate from the Base Bid Price, which the owner may elect to add or deduct from the base bid.

Bid – Written offer by the Bidder for the Work, as specified, which designates the Bidder's Base Bid and Bid Prices for all Alternates.

Bidder – The Person acting directly, or through an authorized representative, who submits a Bid to the Owner.

Bidding Documents – The proposed Contract Documents as advertised, and all Addenda issued before execution of the Contract.

Bid Price – The Bidder's price for a lump sum item of work and/or the product of the Bidder's unit price for an item of Unit Price Work times the quantity given on the Bid Form for that item.

Change Order – A written order issued and signed by the Owner, which amends the Contract Documents for changes in the Work or an adjustment in Contract Price and/or Contract Time.

Contract Time(s) – The Contract Times for the entire Work are the periods allowed, including authorized adjustments, for Substantial Completion and final completion of the Work. The Contract times for a designated portion of the Work are the periods allowed for Substantial Completion and final completion of any such portion of the Work, as specified in the Contract Documents.

Contractor – Business enterprise with which the Owner has entered into the Contract.

Department of Technology, Management & Budget (DTMB) – The Department of Technology, Management and Budget of the State of Michigan.

Drawings – Part of the Contract Documents graphically showing the Work.

Final Completion – The date at which the punch list and all other outstanding construction issues (including documentation) have been completed to the Owner's satisfaction so that final payment and close-out of the project can occur.

Hazardous Material – Asbestos containing materials (ACM), Polychlorinated Biphenyls (PCBs), petroleum products, Lead, or such construction materials as paint thinners, solvents, gasoline, oil, etc., and any other like material the manufacture, use, treatment, storage, transportation or disposal of which is regulated by federal, State or local Laws governing the protection of public health, natural resources or the environment.

Notice of Award – Written notice awarding the Bid to the lowest responsive, responsible Bidder (and establishing the Alternates accepted by the Owner).

Notice to Proceed – Written notice directing the Contractor to commence with construction activities and establishing the start date of the Contract.

Owner – The State of Michigan, with whom the Contractor has entered into the Contract and for whom the Work is to be provided.

PSC – The PSC is the Professional Service Contractor, State Agency, individual, or business entity that has the authority to develop/create the Contract Documents.

Progress Schedule – Work Schedule that shows the Contractor's approach to planning, scheduling, and execution of the Work.

Project Director (PD) – Designated State employee(s) responsible for directing and supervising the PSC and the Contractor.

Shop Drawings – Includes drawings, diagrams, illustrations, standard schedules, performance charts, instructions and other data prepared by or for the Contractor to illustrate some part of the Work, or by a Supplier and submitted by the Contractor to illustrate items of material or equipment.

Soil Erosion and Sedimentation Control – The planning, design and installation of appropriate Best Management Practices designed and engineered specifically to reduce or eliminate the off-site migration of soils via water runoff, wind, vehicle tracking, etc.

Specifications – Parts of the Contract Documents organized into Divisions. "Technical Specifications" means Divisions of the Specifications consisting of technical descriptions of materials, equipment, construction systems, standards, and workmanship.

State – The State of Michigan in its governmental capacity, including its departments, divisions, agencies, boards, offices, commissions, officers, employees and agents.

State Facilities Administration (SFA) – SFA is the part of the DTMB responsible for design, construction, and operations and maintenance of State facilities.

Subcontractor – A person having an agreement with the Contractor to provide labor and furnish materials and/or equipment for incorporation into the Work.

Submittals – Includes technical Submittals, Progress Schedules and those other documents required for submission by the Contract Documents. The term "technical Submittal" includes Shop Drawings, brochures, samples, Operation and Maintenance (O&M) Manuals, test procedures and any other Submittal the Contract Documents require the Contractor to submit to demonstrate how the items covered, after installation or incorporation into the Work, will conform to the information given in the Contract Documents and be compatible with the design of the completed Work as a functioning whole.

Substantial Completion – The Work, or a portion of the Work designated in the Contract Documents as eligible for use for its intended purpose by the Owner except for minor items of repairs and/or touch up which do not affect the Owners use of the Project. (The Minor list of incomplete items is identified by the Owner & PSC called the Punch List.

Supplier – A manufacturer or fabricator, a distributor, or a material person or vendor representing a manufacturer or fabricator, who has an agreement with the Contractor to furnish materials and/or equipment.

Unit Price Work – Work involving specified quantities (i.e., related Work quantities) which when performed is measured by the PSC and paid using the measured quantities and Unit Prices contained in the Contract Documents. Performance of Unit Price Work for undefined quantities is contingent upon conditions encountered at the site as determined and authorized by the PSC.

Work – The entire completed Construction required by the Contract Documents. The Work results from furnishing and performing all services, obligations, responsibilities, management, supervision, labor, materials, equipment, construction equipment, general conditions,

permits, taxes, patent fees and royalties, testing, inspection and approval responsibilities, warranties, temporary facilities, small tools, field supplies, Bonds, insurance, mobilization, close-out, overhead and all connections, devices and incidental items of any kind or nature required and/or made necessary by the Contract Documents.

ARTICLE 2 - The Contract: The Contract is inclusive of all written and graphic documents that form the legal agreement between the Owner and the Contractor consisting of this document, completed and signed Bid, terms and conditions of the Contract, Drawings, specifications, Addenda, Notice of Award, Notice to Proceed and Contract Change Orders. This includes the Pre-Construction Procedures document (DTMB-460).

ARTICLE 3 – Interpretations: The PSC has the responsibility of making “Contract” interpretations. Any questions or clarifications requested by the Contractor must be submitted in writing to the PSC and a copy sent to the Project Director (PD).

ARTICLE 4 - Prevailing Wages, as applicable: Local, state, and federal prevailing wage requirements, to the extent applicable to the Contract, shall be enforced. To the extent applicable, the Contractor is responsible for advising all Subcontractors of any legal or contractual requirement to pay the prevailing wage rates. To the extent applicable, the Contractor and Subcontractors are liable for the payment of the prevailing wage rate to its employees under penalty of law.

ARTICLE 5 - Examination of Premises: The Bidder shall familiarize themselves with the existing conditions of the project work site. The Bidder must take their own field measurements and be responsible for the correctness of same. If the Contractor denotes any deviations between the existing project work site and the Specifications/plans, the Contractor shall properly notify the Owner and/or the PSC in writing. Failure to notify the Owner and/or the PSC will constitute the Contractor’s acceptance of the existing project work site conditions.

ARTICLE 6 - Materials & Equipment (Substitutions, Submittals, Michigan Products): Unless otherwise specified, all materials shall be new and of the best grade of their respective kinds for the purpose of the Work. Whenever an article, material, or equipment is specified by name, a substitute of equal qualifications may only be used upon the written approval of the PSC. All Contractors and Suppliers are encouraged to provide Michigan-made products, recycled products, and/or environmentally friendly products whenever possible where price, quality, and performance are equal to, the requirements of the Contract Documents. The Contractor will be required to use alternatives to landfills for waste disposal such as reuse or recycle of any waste materials to the extent practical. Prior to starting Work, the Contractor must submit to the PSC and receive approval for general design intent for all required samples and all other technical Submittals that are required by the Contract Documents.

ARTICLE 7 - Other Contracts: During the Contract Time, the Owner may contract for other work and/or self-perform work at or adjacent to the project site. In doing so, the Owner will coordinate the operations of the Contractor and the other work. The Contractor must coordinate its activities with the interfacing work and must provide proper and safe access to the site for the other State - contracted work.

ARTICLE 8 - Protections of Work and Property (Cutting & Patching): The Contractor must do all cutting, fitting, or patching of the Work that may be required to assemble all components, or make the new Work join with the existing surface and materials. The Contractor must take proper precautions so as not to endanger any existing conditions or Work in progress. The Contractor must not cut or alter existing structural members or foundations unless specifically required by the Contract Documents. Openings cut in exterior walls and roofs for installation of materials or equipment must be waterproofed by appropriate, approved materials and methods. All adjacent finished surfaces that are damaged by the new Work must be patched and repaired with materials matching existing surfaces. Joints between patched and existing materials must be straight, smooth, and flush. Workers applying patching material must be skilled in the appropriate trade required for the specific installation.

ARTICLE 9 – Insurance: No work connected with this Contract shall be started until the Contractor has submitted evidence to the Director that (i) all workers are insured to protect him/her from claims for damages for personal injury or death which may arise from operations under this Contract and that (ii) he/she is covered by the following types and amounts of insurance:

- A. Commercial General Liability Insurance with a limit of not less than \$1,000,000 each occurrence. If such CGL insurance contains a general aggregate limit, it must apply separately to this project.

The Contractor must list the State, its departments, divisions, agencies, offices, commissions, officers, employees, and agents as ADDITIONAL INSURED on the Commercial General Liability policy.

- B. Contractor must have vehicle liability insurance for bodily injury and property damage as required by law on any auto including owned, hired, and non-owned vehicles used in the Contractor’s business.

The Contractor must list the State, its departments, divisions, agencies, offices, commissions, officers, employers, and agents as ADDITIONAL INSUREDS on the vehicle liability policy.

- C. Worker’s disability compensation, disability benefit or other similar employee benefit act with minimum statutory limits. NOTE:
- (1) If coverage is provided by a State Fund or if Contractor has qualified as a self-insurer, separate certification must be furnished that coverage is in the state fund or that Contractor has approval to be a self-insurer.
 - (2) Any citing of a policy of insurance must include a listing of the States where that policy’s coverage is applicable; and
 - (3) This provision must not be applicable where prohibited or limited by Michigan law.

D. Employer's Liability Insurance with the following minimum limits:

\$1,000,000 each accident
\$1,000,000 each employee by disease
\$1,000,000 aggregate disease

E. ~~***Pollution Liability Insurance in the amounts of not less than \$1,000,000 per occurrence is required.~~

Liability Insurance must be endorsed to list as additional insureds, the Professional's consultants, and agents. Worker's Compensation, Employer's Liability Insurance and all other liability insurance policies must be endorsed to include a waiver of rights to recover from the Owner, Professional, and the other additional insureds. The Contractor's liability insurance must remain in effect through the Correction Period and through any special correction periods. For any employee of the Contractor who is resident of and hired in Michigan, the Contractor must have insurance for benefits payable under Michigan's Worker's Compensation Law. For any other employee protected by Worker's Compensation Laws of any other state, the Contractor must have insurance or participate in a mandatory state fund, where applicable, to cover the benefits payable to any such employee. These requirements must not be construed to limit the liability of the Contractor or its insurers. The Owner does not represent that the specified coverage or limits of insurance are sufficient to protect the Contractor's interests or liabilities.

Builder's Risk Insurance: Unless indicated otherwise in the bid document, the Contractor will purchase and maintain property insurance for 100% of actual cash replacement value of the insurable Work while in the course of construction, including foundations, additions, attachments, and all fixtures, machinery and equipment belonging to and constituting a permanent part of the building structures. The property insurance also will cover temporary structures, materials and supplies to be used in completing the Work, only while on the building site premises or within five hundred feet of the site. The property insurance insures the interests of the Owner, Contractor and all Subcontractors and Suppliers at any tier as their interest may appear. The property insurance insures against "all risk" of physical loss or damage to the extent usually provided in policy forms of insurers authorized to transact this insurance in Michigan. A copy of the master insurance policy will be available for review by the State, upon request. Any deductible shall be both the option and responsibility of the **Contractor**.

The Owner and Contractor intend that the required policies of property insurance must protect all the parties insured and provide primary coverage for all losses and damages caused by the perils covered. Accordingly, to the extent that the insurance company pays claims, the Owner and the Contractor and its Subcontractors/Suppliers waive all rights against each other for any such losses and damages and also waive all such rights against the Professional and all other persons named as insureds or additional insureds.

Partial payments shall not relieve the Contractor from full responsibility for any damage which may result from any cause including fire or other casualty until completion of the Contract and final payment. Any casualties shall not relieve the Contractor from performing the Contract. Insurance Companies must have a rating of A- or better as listed by A.M. Best Company, <http://www.ambest.com>. The State of Michigan must be named as an additional insured.

ARTICLE 10 - Changes in the Work (Unit Prices/Allowances): The Contractor shall make changes in the contracted Work only as ordered in writing by the Owner. The State reserves the right to increase or decrease the quantities of the Work to be performed at the Unit Price by amounts up to 100% of the listed estimated quantities. If cash allowances or provisional allowances are used, the Contractor must obtain written acceptance from the Owner or the PSC before providing items covered under the allowances. On extra work authorized by the Owner, allowance for overhead and profit markups by the Contractor shall not exceed 15% of the cost of Work involved if work is performed by their own forces and up to 5% if work is performed by Subcontractors. However, if work is to be performed by lower tier Subcontractors, the lowest tier Subcontractor performing the work may charge a fee up to 15% of the work involved, plus intermediate Subcontractors and the Contractor must share a maximum fee up to 5% of the lowest tier Subcontractor's cost excluding fees. In no situation shall the total markups for the Contractor and the Subcontractors exceed 20% of the actual work performed. If a dispute arises between the Owner and Contractor on an adjusted price, the Contractor must continue the Work with due diligence during the dispute/disagreement.

ARTICLE 11 - Termination/Disputes/Claims: The Owner may elect to terminate all or any part of the Work if the Contractor fails to complete the Work, or a specified part of the Work, within the corresponding Contract Time; fails or refuses to supply sufficient management, supervision, workers, materials or equipment; or otherwise fails to prosecute the Work, or any specified part of the Work, with the diligence required to comply with the Contract Time(s); the Contractor persistently disregards the authority of the PSC or violates or disregards a provision of the Contract Documents or the Laws of any Political Subdivision with jurisdiction; the Contractor fails to comply with the Michigan Residency Requirements (1984 PA 431, as amended, MCL 18.1241a); or is found to be in violation of Section 4 of 1980 PA 278 concerning unfair labor practices, or any nondiscrimination requirements imposed by Law, including *Executive Directive 2019-09*; at any time, the Contractor, Subcontractor or Supplier is in violation of unfair labor practices prohibited by Section 8 of Chapter 327 of the National Labor Relations Act, 29 U.S.C. 158; or the Contractor violates or breaches any material provision of the Contract Documents. The Owner may, without cause and without prejudice elect to terminate any part of the Work, or the Contract in whole or in part, as the Owner may deem appropriate for its convenience or lack of funding. In the case that the Owner terminates the Contract for its convenience or lack of funding, the Contractor must protect and maintain the Work to make reasonable and diligent efforts to mitigate the cost of the Contract services rendered before the effective date of termination. Claims by the Contractor must be submitted to the PSC and PD for review. The Contractor must carry on the Work with due diligence during all disputes or disagreements. The recommendation from the PSC will be the final and binding claim resolution unless the Contractor

elects to file suit in the Michigan Court of Claims within 30 Calendar Days after the date of the PSC recommendation for claim resolution.

ARTICLE 12 – Payments: The Contractor will be allowed to make no more than two payment requests, for actual work complete and /or materials delivered, over the duration of this contract, with a final payment of not less than six percent (6% - 2+2+2 closeout) of the total Contract amount. The Contractor must make their requests on the DTMB-440 pay request form and attach all backup information as requested by the PSC and/or the PD.

Electronic Funds Transfer: The State will only disburse payments under this Contract through Electronic Funds Transfer (EFT). Contractor must register with the State at <http://www.michigan.gov/SIGMAVSS> to receive electronic fund transfer payments. If Contractor does not register, the State is not liable for failure to provide payment. Without prejudice to any other right or remedy it may have, the State reserves the right to set off at any time any amount then due and owing to it by Contractor against any amount payable by the State to Contractor under this Contract.

ARTICLE 13 - Regulatory Requirements: Contractor shall comply with all federal, state, and local laws, ordinance rules, regulations, orders, codes and other legally enforceable requirements, including the Occupational Health and Safety Act, Michigan Residency Requirements pursuant to 1988 PA 504, Michigan Right to Know Law, and rules, regulations and orders of the Michigan Civil Rights Commission relevant to 1976 PA 453, Section 6. Contractor shall give notice and pay all royalties, building permits, fees and Michigan sales and use taxes.

ARTICLE 14 – Indemnification: To the fullest extent permitted by law, the Contractor shall defend, indemnify and hold harmless the State together with its directors, officers, employees, assignees, agents and shareholders (hereinafter collectively called the "Indemnified Parties"), from and against all claims, demands, suits, obligations, liabilities, damages, losses and judgments, including costs and expenses related thereto (including, but not limited to, reasonable attorney's fees and expenses and any obligation or liability for loss of use or any other incidental or consequential damages, and all fees and expenses incurred by the Indemnified Parties in establishing the right to indemnification hereunder), which may be asserted against, suffered by, charged to or recoverable from the Indemnified Parties by reason of the Contractor's performance of this agreement.

ARTICLE 15 - Temporary Facilities: The Contractor must furnish and install all temporary facilities and controls required to perform the Work, must remove them from State property upon completion of the Work, and the grounds and existing facilities must be restored to their original condition. If utilities are available in the area where Work will be performed, the Contractor will not be charged for reasonable use of these services for the construction operation. The Contractor must pay the costs for installation and removal of any temporary connections including necessary safety devices and controls. Use of utility services must not disrupt or interfere with operations of the State. The Contractor must provide and maintain a sufficient number of portable temporary toilets in locations approved by the State. The Contractor must comply with all federal, state, and local code requirements and must maintain the temporary toilets in a sanitary condition at all times and must remove them when the Work under this Contract is complete. The Contractor's employees may not be allowed to use any existing State toilet facility except by permission. At the beginning of the Work, the Contractor may be required to provide a field office and storage building at the site in a location acceptable to the Owner. Job signs with the Contractor's name, logos, specialty, etc. are not allowed. The Contractor must provide adequate temporary heat to maintain the temperature in those areas of the building where Work is being conducted as required by the Product Manufacturer's installation requirements.

ARTICLE 16 – Testing: The Contractor must assume full responsibility for any testing, inspection, or approvals required to meet code requirements as indicated in the Contract Documents, and as required by material or equipment Suppliers. The Contractor is responsible to make access provisions for all testing and inspections as required. The Owner may contract an independent testing company for certain quality assurance testing. A copy of all reports must be submitted to the PSC and Project Director.

ARTICLE 17 - Contract Time (Schedules): The Contractor shall start the Work on the date established in the Notice to Proceed and shall continue the Work until completed. The Contractor shall submit a construction schedule in a form indicating start dates and finish dates for the total Work and all significant activities of the Work. Normal business working hours are Monday - Friday, 8:00 a.m. - 5:00 p.m., unless otherwise noted, except for State holidays.

ARTICLE 18 - Safety/Cleaning/Working Conditions: The Contractor and its Subcontractors/Suppliers must comply with all applicable federal, State and local laws governing the safety and protection of persons or property, including, but not limited to the Michigan Occupational Safety and Health Act (MIOSHA), 1974 PA 154, as amended. The Contractor is solely responsible for initiating, maintaining and supervising all safety precautions. The Contractor must remove all scrap or removed material, debris, or rubbish from the project work site, including but not limited to roadways, sidewalks, ingress and egress locations, at the end of each working day and more frequently as required. The Contractor cannot discard materials on the grounds of the State Agency without the express permission of the PD. No salvage or surplus material may be sold on the premises of the State Agency. No burning of debris or rubbish is allowed. Before final acceptance by the State, the Contractor must clean all the Work and existing surfaces, building elements and contents that were soiled by their operations and make repairs for any damage or blemish that was caused by the Work. The Contractor must furnish, install, and maintain and remove when no longer required: adequate barriers, warning signs or lights at all dangerous points throughout the Work for protection of property, workers, and the public. The Contractor must maintain at the site one copy of safety data sheets (SDS), one copy of all as-built/record documents and approved Submittals, clarifications, and interpretations.

ARTICLE 19 – Supervision: Contractor shall enforce good order among the workforce and shall not employ any disorderly, intemperate, or unfit person or anyone not skilled in the work assigned to him/her. The Contractor shall employ a competent person

having authority to act for them who shall be always at the worksite when work is being done at the site. He shall have the Contract Documents, Plans/Drawings, Specifications and approved Shop Drawings available on the site at all times. The Contractor must maintain and furnish promptly to the Owner and the Professional upon their request daily field reports and photos recording the on-site labor force and equipment (Contractor and Subcontractors); materials/equipment received; visits by Suppliers; significant in-progress and completed trade Work within major areas; and other pertinent information.

ARTICLE 20 - Project Closure (Record Documents, Guarantees, Warrantees): The Contractor must notify the PSC and the PD when the Work is substantially complete. If the PSC and PD agree that the project is Substantially Complete, a punch list will be developed and attached to the Certificate of Substantial Completion. The Contractor must complete all punch list items by an agreed upon correction period. The Contractor must prepare and submit the following documentation before requesting final inspection or final payment: final operating and maintenance manuals, warranties, inspection certificates, as-built/record documents, Contractor's 'Guarantee and Indebtedness Statement' (DTMB-437) and complete all other Contract requirements.

ARTICLE 21 - Subcontractors/Suppliers/Assignments: The Owner assumes no contractual obligations to anyone other than the Contractor. The Contractor cannot assign his contract responsibilities to others. The Owner reserves the right to reject or revoke, for its convenience, any Subcontractor/Supplier. Work performed by any Subcontractor or Supplier must comply with all contract requirements.

ARTICLE 22 - Hazardous Materials/Environmental Requirements: If the Contractor encounters material reasonably believed to be Hazardous Material, which was not described in the Bid Documents and was not generated or brought to the site by the Contractor, the Contractor must immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions in accordance with all federal, state, and local laws. Upon receipt of the notice, the Owner will investigate the conditions and may stop the Work and terminate the affected Work or the Contract for convenience, may contract others to have the Hazardous Material removed or rendered harmless, or issue a written Contract Change Order to amend the Contract Price/Time. If the Hazardous Material is brought to the site by the Contractor or as a result in whole or in part from its violation of any law covering the use, handling, storage, disposal of, processing, transport and transfer or from any other act or omission within its control, the Contractor is responsible for the delay and costs to clean up the site, remove and render harmless the Hazardous Material to the satisfaction of the Owner and all political subdivisions with jurisdiction. The Contractor and its Subcontractors/Suppliers must comply with all applicable federal, State and local environmental laws, standards, orders or requirements including but not limited to the National Environmental Policy Act of 1969, as amended, Michigan Natural Resources and Environmental Protection Act, P.A. 451 of 1994, as amended, Clean Air Act, as amended, Clean Water Act, as amended, Safe Drinking Water Act, as amended, Pollution Prevention Act, as amended, Resource Conservation and Recovery Act, as amended, National Historic Preservation Act, as amended, and Energy Policy and Conservation Act and Energy Standards for Buildings, except Low-Rise Residential Buildings, ANSI/ASHRAE/IESNA Standard 90.1-1999.

ARTICLE 23 - Security Clearances: Contractor must comply with all special security requirements of the agency where work is to be performed. Access to and egress from the buildings and grounds must be via routes specifically designated by the State agency. All security clearances from the agency where work is being performed must be obtained prior to starting Work.

ARTICLE 24 - Defective Work: Defective work must be replaced at the cost of the Contractor. If adjacent work is damaged by the removal and replacement of defective work and/or products, the Contractor shall restore these areas to their original condition at the Contractor's expense. Defective work may include poor workmanship, work not meeting code requirements or the requirements of the Contract Documents, or work not installed per manufacturer's requirements. The Contractor may also be held responsible for time delays or added costs to the Owner caused by the repair/replacement of defective work.

ARTICLE 25 - Soil Erosion and Sedimentation Control: All Work under this Contract must meet the storm water management requirements of the project and comply with the applicable Soil Erosion and Sedimentation Control (SESC) rules and regulations and specific provisions for same within the Contract Documents. SESC measures will be monitored and enforced by State Facilities Services Administration (SFA), or another authorized enforcing agency if so delegated, through the review of the Contractor's implementation plans and site inspections. SFA or the PSC will notify the Contractor in writing of any violation(s) of the applicable SESC statutes and/or the corrective action(s) undertaken by the Owner and may issue stop work orders. SFA has the right to assess a fine to the Contractor for noncompliance with the provisions of the Contract Documents and/or SESC regulations applicable to this Work and fines must be in addition to any other remediation costs applicable to the project and may exceed the value of the Contract. Soil erosion and sedimentation control in the State of Michigan is regulated under The Natural Resources Environmental Protection Act; Soil Erosion and Sedimentation Control, 1994 PA 451, Part 91, as amended, MCL 324.9101 et seq

ARTICLE 26 - Warrantees/Guarantee: The Contractor must furnish the State with a written guarantee (DTMB-437 Form) to remedy any defects due to faulty materials or workmanship for the specified warranty period. The manufacturer warranties for materials and equipment, as specified, must be appropriately transferred to the Owner.

DIVISION 01
GENERAL REQUIREMENTS

SECTION 01040 COORDINATION

1. Project Coordination:

- (a) Before beginning Work the Contractor must coordinate with the State Agency representative to implement the schedule for the Project. Once the Project is started, it must be carried to completion without delay.(b)Any building utility service interruptions or outages including security required by the Contractor in performing the Work must be prearranged with the staff of the State Agency and must occur only during those scheduled times.(c) The Contractor is not responsible for removing room furnishings unless is required by the Contract Documents.

2. Cutting and Patching:

- (a) The Contractor must do all cutting, fitting, or patching of the Work that may be required to complete the Work. The Contractor must take proper precautions so as not to endanger any existing Work. The Contractor must not cut or alter existing structural members or foundations unless specifically required by the Contract Documents. Coordinate in advance all cutting and patching to limit impacts to all building systems (roofing, waterproofing, fire rating, mechanical, electrical, etc.). Use temporary supports and/or protection to maintain integrity and prevent damage to adjacent or surrounding areas. Complete cutting and patching using methods to maintain any existing warranties. Utilized identical materials and methods for patching to match existing. Elevate any cutting and patching concerns via RFI to confirm acceptable methods where necessary.
- (b) Holes or openings cut in exterior walls and roofs for installation of materials or equipment must be waterproofed by appropriate, approved materials and methods.
- (c) All adjacent finished surfaces that are damaged by the new Work must be patched with materials matching existing surfaces. Joints between patched and existing material must be straight, smooth, and flush. Workers skilled in its installation must apply all patching material.

END OF SECTION 01040

SECTION 01060 REGULATORY REQUIREMENTS

- 1. **Laws:** The Contractor and its Subcontractors/Suppliers must comply with all Federal, State, and local Laws applicable to the Work and site.
- 2. **Codes:** All Works must be provided in accordance with the State Construction Code Act, 1972 PA 230, as amended, MCL 125.1501 et seq., International Building and Residential Codes and all applicable Michigan construction codes and fire safety including but not limited to: Michigan Building Code, Michigan Residential Code, Michigan Uniform Energy Code, Michigan Electrical Code, Michigan Rehabilitation Code for Existing Buildings, Michigan Mechanical Code, Michigan Elevator Code and Michigan Plumbing Code. All Work shall also comply with applicable State regulations, public health codes, BFS, EGLE/USACE, MDOT, local health department codes and requirements. If the Contractor observes that any Contract Document conflicts with any Laws or the State Construction Code or any permits in any respect, the Contractor must promptly notify the Professional in writing. If the Contractor provides any Work knowing or having to reason to know of such conflict, the Contractor must be responsible for that performance.
- 3. **Permits:** All required construction permits must be secured and their fees including inspection costs must be paid by the Contractor. The time incurred by the Contractor in obtaining construction permits must constitute time required to complete the Work and does not justify any increases to the Contract Time or Price, except when revisions to the Drawings and/or Specifications required by the permitting authority cause the Delays. The Contractor must pay all charges of Public Utilities for connections to the Work, unless otherwise provided by Cash Allowances specific to those connections. The following permit fees will be paid by the Owner
- 4. **Taxes:** The Contractor must pay all Michigan sales and use taxes and any other similar taxes covering the Work that are currently imposed by legislative enactment and as administered by the Michigan Department of Treasury, Revenue Division. If the Contractor is not required to pay or bear the burden or obtains a refund of any taxes deemed to have been included in the Bid and Contract Price, the Contract Price must be reduced by a like amount and that amount, whether as a refund or otherwise, must ensure solely to the benefit of the State of Michigan.
- 5. **Safety and Protection:** The Contractor and its Subcontractors/Suppliers must comply with all applicable Federal, State, and local Laws governing the safety and protection of persons or property, including, but not limited to the Michigan Occupational Safety and Health Act (MIOSHA), 1974 PA 154, as amended, MCL 408.1001 et seq., and all rules promulgated under the Act. The Contractor is responsible for all damages, injury or loss to the Work, materials, equipment, fines, penalties as a result of any violation of such Laws, except when it's due to the fault of the Drawings or Specifications or to the Act, error, or omission of the Owner or Professional. The Contractor is solely responsible for initiating, maintaining, and supervising all safety

precautions and programs and such responsibility must continue until such time as the Professional is satisfied that the Work, or Work inspected, is completed and ready for final payment. In doing the Work and/or in the event of using explosives, the Contractor must take all necessary precautions for the safety of, and must erect and maintain all necessary safeguards and provide the necessary protection to prevent damage, injury or loss to: (a) all employees on the Work and other persons who may be affected by the Work, (b) all the Work and materials and equipment to be incorporated into the Work, whether stored on or off the site, and (c) other property at or adjacent to the site, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and Underground Utilities not designated for removal, relocation or replacement. In the event of severe weather, the Contractor must inspect the Work and the site and take all reasonably necessary actions and precautions to protect the Work and ensure that public access and safety are maintained.

6. Fire Hazard Conditions:

- (a) The fire hazard classification of finish materials where used in the specification must be in accordance with the current Michigan Building Code.
- (b) Classification must be determined by tunnel test in accordance with National Fire Protection Association (NFPA-255), American Society for Testing Materials (ASTM E-84) or Underwriters' Laboratories, Inc. (UL-723).

7. Flame/Smoke Resistance Standards: The Contractor must provide carpeting complying with "Class B" requirements as set forth in Michigan Department of State Police State Fire Safety Board "Health Care Facilities Fire Safety Rules" R29.1243, Rule 243, when tested in accordance with the following procedures:

- (a) Tunnel Test: Test for surface burning characteristics, with ratings for flame spread, fuel contribution, and/or smoke density; ASTM E 84, UL 723, or NFPA No. 255.
- (b) Pill Test: Test for flammability; ASTM D 2859, or DOC FF-1-70.
- (c) Floor Radiant Panel Test: Test for burning under varying radiant energy levels; ASTM E 648, with minimum average radiant flux ratings not less than 0.45 watts/sq. cm.
- (d) Smoke Density Test: Test in radiant heat chamber, with and without flame, for density of smoke generated; ASTM E 662, or NFPA No. 258, also known as NBS Smoke Density Chamber Test.***

8. Michigan Right-To-Know Law: The Contractor and its Subcontractors/Suppliers must comply with MIOSHA, Michigan Right-to-Know Law (Public Act 80 of 1986) and the rules promulgated under it. The Act places certain requirements on employers to develop a communication program designed to safeguard the handling of hazardous chemicals through labeling of chemical containers and development and availability of Safety Data Sheets (SDS), and to provide training for employees who work with these chemicals and develop a written hazard communications program. The Act also provides for specific employee rights, including the right to be notified of the location of SDS and to be notified at the site of new or revised SDS within five Business Days after receipt and to request SDS copies from their employers. The Contractor, employer or Subcontractor must post and update these notices at the site.

9. Environmental Requirements: The Contractor and its Subcontractors/Suppliers must comply with all applicable Federal, State and local environmental Laws, standards, orders or requirements including but not limited to the National Environmental Policy Act of 1969, as amended, Michigan Natural Resources and Environmental Protection Act, P.A. 451 of 1994, as amended, the Clean Air Act, as amended, the Clean Water Act, as amended, the Safe Drinking Water Act, as amended, Pollution Prevention Act, as amended, Resource Conservation and Recovery Act, as amended, National Historic Preservation Act, as amended and Energy Policy and Conservation Act and Energy Standards for Buildings Except Low-Rise Residential Buildings, ANSI/ASHRAE/IESNA Standard 90.1.

10. Nondiscrimination: For all State Contracts for goods or services in amount of \$5,000 or more, or for Contracts entered into with parties employing three or more employees; in connection with the performance of Work under this Contract, the Contractor and its Subcontractors and Suppliers must comply with the following requirements:

- 10.1 Not to discriminate against any employee or applicant for employment because of race, color, religion, national origin, age, sex (*as defined in Executive Directive 2019-09*), height, weight or marital status and take affirmative action to ensure that applicants are employed, and the employees are not subject to such discrimination. Such action must include, but is not limited to, the following: employment, upgrading, demotion or transfer; recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training.
- 10.2 To state in all solicitations or advertisements for employees that all qualified applicants will receive consideration for employment without regard to race, color, religion, national origin, age, sex, height, weight, or marital status.

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- 10.3 To send, or have its collective bargaining representative send, each labor union or representative of workers with which there is a collective bargaining agreement or other contract or understanding, a notice advising the labor unions or workers' representative of the commitments under this provision.
 - 10.4 To comply with the Elliot-Larsen Civil Rights Act, 1976 PA 453, as amended, MCL 37.2201 et seq.; the Michigan Persons with Disability Civil Rights Act, 1976 PA 220, as amended, MCL 37.1101 et Seq.; *Executive Directive 2019-09*; and all published rules, regulations, directives, and orders of the Michigan Civil Rights Commission (MCRC) which may be in effect on or before the date of Bid opening.
 - 10.5 The Contractor must furnish and file compliance reports within the times, and using the forms prescribed by the MCRC. Compliance report forms may also elicit information as to the practices, policies, programs, and employment statistics of the Contractor and Subcontractors. The Contractor must permit access to Records by the MCRC and its agent for purposes of ascertaining compliance with the Contract and with rules, regulations, and orders of the MCRC.
 - 10.6 If, after a hearing held under its rules, the MCRC finds that the Contractor has not complied with the Elliott-Larson requirements of the Contract Documents, MCRC may, as part of its order, certify its findings to the Administrative Board of the State of Michigan, which may order the cancellation of the Contract and/or declare the Contractor ineligible for future contracts with the State until the Contractor complies with the MCRC's order.
 11. **Michigan Residency for Employees:** Fifty percent of the persons employed on the Work by the Contractor must have been residents of the State of Michigan for not less than one year before beginning employment on the Work. This residency requirement may be reduced or waived to the extent that Michigan residents are not available or to the extent necessary to comply with the federal funds used for the Project. This requirement does not apply to employers who are signatories to collective bargaining agreements that allow for the portability of employees on an interstate basis.

END OF SECTION 01060

SECTION 01100 PROJECT PROCEDURES

1. **Signage and Safety:** The Contractor must post appropriate construction signs to advise the occupants and visitors of occupied facilities of the limits of construction work areas, hardhat areas, excavations, construction parking and staging areas, etc. Advertising signage by contractors, subcontractors, or suppliers is not allowed. The Contractor must maintain safe and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, hospitals, fire, and police stations and like establishments. The Contractor must obtain written approval from the Owner ten Calendar Days before connecting to existing facilities or interrupting the services on site.
2. **(SECTION NOT USED)**
3. **Barrier and Enclosures:**
 - (a) The Contractor must furnish, install, and maintain as long as necessary and remove when no longer required adequate barriers, warning signs or lights at all dangerous points throughout the Work for protection of property, workers, and the public. The Contractor must hold the State of Michigan harmless from damage or claims arising out of any injury or damage that may be sustained by any person or persons as a result of the Work under the Contract.
 - (b) **Temporary Fence:** Where trenches are left open when unattended, the Contractor must entirely enclose the Contract area by means of woven wire or snow fence having minimum height of four feet. Gates must be provided at all points of access. Gates must be closed and secured in place at all times when Work under the Contract is not in progress. The fence must be removed, and grounds restored to original condition upon completion of the Work.
4. **Construction Aids:**
 - (a) The Contractor must furnish, install, and maintain as long as necessary and remove when no longer required, safe and adequate scaffolding, ladders, staging, platforms, chutes, railings, hoisting equipment, etc., as required for proper execution of the Work. All construction aids must conform to Federal, State, and local codes or Laws for protection of workers and the public.
 - (c) **Pumping and Drainage:** The Contractor must provide all pumping necessary to keep excavations and trenches free from water the entire period of Work on the Contract. The Contractor must construct and maintain any necessary surface drainage systems on the Work site so as to prevent water entering existing structures or to flow onto public or private property adjacent

to the Agency's land, except for existing drainage courses or into existing drainage systems. The Contractor must prevent erosion of soils and blockage of any existing drainage system.

END OF SECTION 01100

SECTION 01200 PROJECT MEETINGS

1. **Pre-Construction Conferences:** The Project Director will schedule a pre-construction conference to be attended by the Professional, State Agency staff, and the Contractors. A project procedure as outlined in Form DTMB-0460, will be established for the Work during the pre-construction meeting. When no organizational meeting is called, the Contractor, before beginning any Work, must meet with the staff of the Agency and arrange a Work schedule for the Project. Once the Project has been started, the Contractor must carry it to completion without delay.
2. **Progress Meetings:** The Professional will schedule progress meetings to be held on the job site whenever needed to supply information necessary to prevent job interruptions, to observe the Work or to inspect completed Work. Progress meetings will generally be biweekly unless the progress dictates otherwise. The Contractor must be represented at each progress meeting by persons with full authority to act for the Contractor in regard to all portions of the Work.

END OF SECTION 01200

SECTION 01300 SUBMITTALS

1. **Shop Drawings, Samples and Technical Submittals:** .
 - 1.1 **Contractor's Review:** Before each submission, the Contractor must:
 - (a) determine and verify all field measurements, quantities, dimensions, instructions for installation and handling of equipment and systems, installation requirements (including location, dimensions, access, fit, completeness, etc.), materials, color, catalog numbers and other similar data as to correctness and completeness, and
 - (b) have reviewed and coordinated that technical Submittal with other technical submittals and the requirements of the Contract Documents.
 - 1.2 **Notice of Variation:** The Contractor must give the Professional specific written notice of any variation from the requirements of the Contract Documents.
 - 1.3 **Contractor's Approval:** The Contractor shall not submit unapproved submittals. Each submittal shall be stamped/certified to indicate that the submittal satisfies the requirements of the Contract Documents before submission to the Professional.
 - 1.4 **Responsibility and Authority:** Neither the Owner's authority to review any of the Submittals by the Contractor, nor the Owner's decision to raise or not to raise any objections about the Submittals, creates or imposes any duty or responsibility on the Owner to exercise any such authority or decision for the benefit of the Contractor/Subcontractor/Supplier, any surety to any of them or any other third party. The Contractor is not relieved of responsibility for errors or omissions in shop drawings, product data, samples, or similar submittals just because the Professional approved them for general design intent.
 - 1.5 **Final As-Built/Record Documents and Submittals:** The approved Submittals are a part of the final As-Built/Record Documents required for processing final payment to the Contractor.
 - 1.6 **Submissions:** Contractor must submit to the Professional:
 - (a) An organized and indexed .pdf electronic file(s) of the submittal(s) and one bond copy of all Shop Drawings.
 - (b) all required samples; and
 - (c) all other technical submittals (test, results, test and safety procedures, O&M manuals, etc.) that are required by the Contract Documents. In addition to electronic copies up to 2 hard copies of the approved O&M manuals may be required to be provided to the agency
 - 1.7 **Professional's Review and Return:** Professional's Review and Return: Submittals will be returned to the Contractor within fifteen Calendar Days. The Contractor is responsible for any time Delay and any cost incurred by the Professional, Contractor or Subcontractors/Suppliers as a result of resubmissions and re-reviews of a particular Submittal. The Contractor shall revise, and correct submittals returned for revision and resubmittal until approval by the Professional is achieved. All time consumed by the resubmissions and re-reviews of a particular Submittal shall constitute time required to furnish that Submittal or shall represent Delays not justifying any increase in Contract Time or Contract Price, or both.

2. Progress Schedule:

2.1 SUMMARY

A. The **Contractor** will submit CPM Progress Schedules to the **Owner** depicting its approach to prosecution of the Work. This includes but is not limited to the **Contractor's** approach to recovering schedule and managing the effect of changes, substitutions, and Delays on Work sequencing.

B. The Progress Schedule will include the Rev. 0 Submittal (par. 2.14), Update Submittals (par. 2.15) and Revision Submittals (par. 2.16). Each Submittal will be assigned a unique number. For a resubmission, the initial number will be modified by the letter A, B, C, etc., as appropriate.

C. Through the Progress Schedule, the **Owner** will seek to stay current on progress, updated Activity and Milestone Dates, and the **Contractor's** approach to Work remaining.

D. References to the Critical Path Method (CPM) are to CPM construction industry standards that are consistent with the requirements of this Section.

2.2 RELATED SECTIONS

A. Section 00700 General Conditions; and Section 00800 Supplementary Conditions.

2.3 GLOSSARY OF TERMS

A. Capitalized terms not already defined in any Division 0 Specification have the following intent and meanings:

1. Milestone—A key point of progress, designating interim targets toward the Contract Times. They may pinpoint critical path foundations, key deliveries, building framing, start of MEP rough-in, building enclosure, partitions, interior finishes, conditioned space, commissioning stages, Substantial Completion, and other events of like import.

2. Official Schedule—The most recent Revision Submittal returned to the **Contractor** as Resubmittal Not Required. The Rev. 0 Official Schedule is the *As-Planned* Schedule.

3. Revision 0 Submittal—Progress Schedule submitted by the **Contractor** depicting the entire Work as awarded.

4. Update Submittal—A monthly Progress Schedule update reflecting progress and minor adjustments on the Activities, sequencing and restraints for Work remaining.

5. Float—Calendar Days between the **Contractor's** anticipated date for early completion of the Work, or of a specified portion of the Work, if any, and the corresponding Contract Time.

2.4 QUALITY ASSURANCE

A. The **Contractor** will obtain a written interpretation from the **Professional**, if the **Contractor** believes the selection of Activities, logic ties or restraints requires an interpretation of the Contract Documents. With each submission, the **Contractor** will point out by specific, written notation, any Progress Schedule feature that may reflect variations from any requirements of the Contract Documents.

B. The **Contractor** is responsible to obtain information from each Subcontractor and Supplier when scoping their respective Activities, Values, logic ties and restraints

C. No review of any Progress Schedule by or on behalf of the **Owner** will relieve the **Contractor** from complying with the Contract Times and any required sequence of Work or from completing Work omitted from the Progress Schedule. No review will imply approval of any variation from or interpretation of the Contract Documents, unless approved by the **Professional** through a written interpretation or by means of a separate, written notation.

2.5 ALLOWANCES

A. Work covered by Cash Allowances will be completed within the Contract Times. To the extent reasonable and consistent with the **Contractor's** plan, Work authorized by provisional contingency allowances will be completed within the Contract Times. The Progress Schedule will incorporate the **Contractor's** best estimate of the Activities, logic and restraints required, using the information in the Contract Documents, or as indicated by the **Professional** in writing.

2.6 "OR EQUALS" AND SUBSTITUTIONS

A. Activities in the Rev. 0 Progress Schedule will be based on materials and equipment required by the Contract Documents and will not reflect any "or equal" or substitute materials or equipment, even if the **Contractor** intends to pursue "or equal" and substitution proposals. This limitation also applies to any Means and Methods indicated in or required by the Contract Documents.

2.7 MEASUREMENT AND PAYMENT

A. The Schedule of Values will include a Progress Schedule *pay item*. Fifteen percent (15%) of this *pay item* will be eligible for payment upon delivery of the *complete* Rev. 0 Submittal. The balance of this *pay item* will be eligible for payment, on a prorated basis, with each Request for Payment attaching an Update Submittal.

2.8 PROGRESS SCHEDULE SUBMITTALS

A. Each Progress Schedule Submittal will consist of an electronic copy the **Contractor's file**, a narrative and a PDF file of the project schedule report and plots, each file appropriately titled for the schedule version and date of publishing.

B. The CPM scheduling software will be Primavera Project Planner®, SureTrak® or Microsoft Project®.

C. In addition to the monthly update schedule submittal, **Contractor** shall provide prior to each Progress Meeting, a 2-week look ahead schedule extracted from the current overall schedule and providing sufficient additional activity detail to appropriately define the expected activity during the upcoming 2-week period.

2.9 PRINTOUTS

A. Schedule Reports will include Activity (ID) code and description, duration, calendar, Early Dates, Late Dates and Total Float, all of which will comport with the requirements of paragraph 8.3.4 of Section 00700 General Conditions.

1. Late Finish Date for an Activity pinpointing a Contract Time will equal that Contract Time. Early Start Date for an Activity designating a Contract restraint will equal the proper Notice to Proceed date. Schedule Reports may or may not append CPM Plots (time-scaled Activity/logic).

2. For Precedence Diagram Method, separate Schedule Reports will tabulate, for each Activity, all preceding and succeeding logic types and lead times, whether CPM Plots displaying vertical logic ties are appended or not.

B. CPM Schedule Plots will be plotted on a suitable time scale and identify the Contract Times, Critical Paths, and sub-Critical Paths. Activities will be shown on the Early Dates with Total Floats noted by Late Date flags.

c. Line of Balance Plots will reflect industry practice for repetitive construction and will segregate the production lines for all trades within the hammock Activities.

2.10 NARRATIVE REQUIREMENTS

A. In general, a narrative will describe the **Contractor's** approach to prosecution of the Work, subject to the requirements of the Contract Documents. Further, each narrative will list the Critical Path Activities and compare Early and Late Dates with Contract Times and Milestone Dates. The basis for restraint dates will be explained.

B. For each Update Submittal, the narrative will compare current Dates to the respective Milestone Dates, describe changes in crewing and construction equipment and identify new Delays. For each Revision Submittal, the narrative also will itemize changes in Activities, logic ties and restraint dates made necessary by each change, Delay, schedule recovery, substitution and **Contractor**-initiated revision occurring since the previous Submittal.

2.12 ACTIVITY REQUIREMENTS

A. The Progress Schedule will detail Work sequencing only to the extent necessary to allow the **Owner** to correlate percent complete, compare actual dates with Milestones and Contract Times and the data in Requests for Payment.

B. Separate Activities will designate permits, construction, Submittal preparation/review (and resubmission and re-review, for same); MEP coordination drawings; deliveries; commissioning; and Punch List. Separate Activities will designate **Owner**-furnished items, interface with other work and the **Owner** and **Professional's** responsibilities.

C. Activities will be detailed only to the extent required to show the transition of trade Work. Activities will detail the progression through site/excavation, foundations, building framing, start/completion of interior partitions, MEP rough-in, building enclosure, interior finishes, conditioned space, and commissioning.

1. Submittal Activities will segregate long-lead items, any item requiring structural access and other procurements that, in the **Contractor's** judgment, may bear on the rate of progress. Separate MEP coordination drawing Activities will be used for each floor. Beyond these requirements, it is not necessary to burden the Progress Schedule with Activities for less significant Submittals and deliveries.

2. For multiunit Work (e.g., rough-in overhead MEP for each floor, etc.), detailed Activities will be shown for a typical (often, the first) unit). Other or follow-on units may be replicated, as appropriate, or modeled with a hammock Activity combining the sum total of the typical detailed Activities. Separate Activities, as may be suitable to the Divisions of Work involved, will be identified for single-unit Work. This requirement applies to such scope as Work in mechanical rooms, building framing, commissioning, etc.

3. Activities will not combine separate or non-concurrent items of Unit Price or lump sum Work, Work in separate structures and Work in distinct areas, locations or floors within an area or structure; or rough-in and finish Work.

D. Activity durations will equal the Calendar Days required to sufficiently complete the Work designated by the Activity (i.e., when finish-to-start successors may start, even if the Activity is not quite 100% complete).

E. Activities will be assigned consistent descriptions and identification codes. Sort codes will group Activities by building or structure, floor or area, Change Order and Change Authorization and other meaningful schemes.

2.13 FLOAT TOLERANCES

A. Any Progress Schedule with Early Dates after a Contract Time will yield negative Total and Contract Floats, whether shown/calculated or not. Any Revision Submittal with less than 20% of Float may be returned as "Revise and Resubmit," unless a time extension is requested, or the **Owner** withholds liquidated damages or asserts intent to do so in the event schedule is not recovered.

2.14 REVISION 0 (Rev. 0) SUBMITTAL

A. The complete Revision 0 Submittal will be due with the first Request for Payment. The Rev. 0 Submittal will show the Work as awarded, without Delays, "or equal" or substitutions, Change Orders or Change Authorizations.

1. The Rev. 0 narrative will detail the **Contractor's** management of the site (lay down, parking, etc.). Further, the Rev. 0 narrative will identify shifts, weekend Work, Activity calendars, Delays since award and all pending and anticipated "or equal" and substitution proposals.

B. Once endorsed by the **Owner** and returned as "Resubmittal Not Required," the Rev. 0 Progress Schedule (or Rev. 0A, etc.) will be the As-Planned Schedule and the basis for Update Submittals until the Rev. 1 Official Schedule is established. Once the As-Planned Schedule is established, the **Owner** will select Milestones and note Milestone Early and Late Dates. As the Official Schedule evolves, Milestone Dates will be revised accordingly.

D. If the **Owner** refuses to endorse the Rev. 0 Submittal (or Rev. 0A, for a resubmission) as "Resubmittal Not Required," the As-Planned Schedule will not be established. In that event, the **Contractor** will continue to submit Update and Revision Submittals

reflecting progress and the **Contractor's** approach to remaining Work. The **Owner** will rely on the available Update and Revision Submittals, subject to whatever adjustments it determines appropriate.

2.15 UPDATE SUBMITTALS

A. Update Submittals with progress up to the closing date and updated Early and Late Dates for progress and remaining Activities will be due with each Request for Payment. As-built data will consist of actual start dates, percent complete, actual finish dates, changes, Delays, and other significant events occurring before the closing date.

2.16 REVISION SUBMITTALS

A. Progress Schedule Revisions will be submitted with the third Request for Payment and every two (2) months after that, or more often, if necessary due to schedule recovery or other Progress Schedule revisions. Revisions will revise the Update Submittal attached to the prior Request for Payment.

B. Progress Schedule revisions will detail all impacts on pre-existing Activity scope, logic ties and restraint dates and reflect the Contractor's current approach to Work remaining. Revisions may be required because of changes in the Work, substitutions, schedule recovery and Delays.

C. Once endorsed by the **Owner** and returned as "Resubmittal Not Required," a Revision Submittal becomes the Rev. 1, Rev. 2, etc. Official Schedule and the basis for subsequent Update Submittals until a more current Official Schedule is established. If the **Owner** refuses to endorse a Revision Submittal as "Resubmittal Not Required," the **Contractor** will continue to submit Update and Revision Submittals when and as required in this Section.

2.17 RETROSPECTIVE DELAY ANALYSIS

A. If the **Owner** refuses to endorse any Revision Submittal as "Resubmittal Not Required," the **Contractor** and **Owner** will use the latest Official Schedule when evaluating the effect of Delays on Contract Time and/or Contract Price. The procedure will consist of progressively revising the latest Official Schedule at key Revision Submittal closing dates. For each Progress Schedule iteration, slippage between actual Milestone Dates and Rev. 0 Milestone Dates will be correlated to Delays occurring solely in that iteration. Revisions affecting Work after any iteration will be included only to the extent consented by the **Owner** at that time and/or if confirmed by as-built progress.

3. **Submittals:** The Contractor shall deliver submittals of products, materials, assemblies, or equipment to the Professional for items indicated in the technical sections.
4. **Samples:** For items indicated in the technical sections, the Contractor must deliver all samples of material or equipment to the job site for examination by the State Agency and the Professional. Samples will be examined by the Professional for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents. The Contractor must furnish all Work in accordance with approved samples. The following general classifications of material and equipment require submission of samples. Samples of other items may be requested by the Professional at any time.

END OF SECTION 01300

SECTION 01400 QUALITY CONTROL

1. **Testing Laboratory Services:** All tests required by the Owner must fulfill ASTM, ANSI, Commercial and other Standards for testing. The following general classifications of Work require submission of test reports and/or certificates of inspection. Additional testing may be requested by the Professional at any time. All testing to be paid for by the Owner.

<u>Item of Work</u>	<u>Test Type</u>	<u>Section Number</u>
Earthwork	Compaction and Density	02200

END OF SECTION 01400

SECTION 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1. The Contractor must furnish and install all temporary facilities and controls required by the Work, must remove them from State property upon completion of the Work, and the grounds and existing facilities must be restored to their original condition.
2. If water or electricity is available in the area where Work will be performed, the Contractor will not be charged for reasonable use of these services for construction operation. The Contractor must pay costs for installation and removal of any temporary connections including necessary safety devices and controls. Use of services must not disrupt or interfere with operations of the State Agency.
3. **Temporary Sanitary Facilities:**

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- (a) **Portable Toilets:** The Contractor must provide and maintain a sufficient number of portable temporary toilets in locations approved by the State Agency. They must comply with all Federal, State, and local code requirements. The Contractor must maintain the temporary toilets in a sanitary condition at all times and must remove them when the Work under this Contract is complete. The Contractor's employees are not allowed to use any existing State toilet facility.

END OF SECTION 01500

SECTION 01600 MATERIAL AND EQUIPMENT

1. The Contractor must furnish and be responsible for all materials, equipment, facilities, tools, supplies and utilities necessary for completing the Work. All materials and equipment must be provided as described in the Contract Documents and of good quality, free of defect and new and must be applied, installed, connected, erected, used, cleaned and conditioned following the manufacturer's and Suppliers' instructions.
2. **Delivery, Storage, and Handling:** All materials and equipment delivered to and used in the Work must be suitably stored and protected from the elements. The areas used for storage must only be those approved by the State Agency. The Owner assumes no responsibility for stored material. The ownership and title to materials will not be vested in the Owner before materials are incorporated in the Work unless payment is made by the Owner for stored materials and equipment. After delivery, before and after installation, the Contractor must protect materials and equipment against theft, injury, or damage from all causes. For all materials and equipment, the Contractor must provide complete information on installation, operation, and preventive maintenance.
 - (a) The Contractor must cover and protect bulk materials while in storage which are subject to deterioration because of dampness, the weather or contamination. The Contractor must keep materials in their original sealed containers, unopened, with labels plainly indicating manufacturer's name, brand, type, and grade of material and must immediately remove from the Work site containers which are broken, opened, watermarked and/or contain caked, lumpy, or otherwise damaged materials.
 - (b) The Contractor must keep equipment stored outdoors from contact with the ground, away from areas subject to flooding and covered with weatherproof plastic sheeting or tarpaulins. The Contractor must certify that any materials stored off-site are:
 - a) Stored on property owned or leased by the Contractor or owned by the agency.
 - b) Insured against loss by fire, theft, flood, or other hazards.
 - c) Properly stored and protected against loss or damage.
 - d) In compliance with the plans and specifications.
 - e) Specifically allotted, identified, and reserved for the project.
 - f) Itemized for tracking and payment.
 - g) Subject to these conditions until the items are delivered to the project site.

END OF SECTION 01600

SECTION 01650 FACILITY START-UP

1. **Tests:** The complete installation consisting of the several parts of equipment and systems installed according to the requirements of the Contract Documents must be ready in all respects for use by the State Agency and must be subjected to a test at full operating conditions and pressures for normal conditions of use.
2. **Adjustments:** Contractor must adjust and replace the Work which is necessary to fulfill the requirements of the Contract Documents and to comply with the directions and recommendations of the manufacturer of the several parts of equipment, and to comply with all provisions of architectural and/or engineering drawings/specifications and all codes and regulations which may apply to the entire installation.
3. **Demonstration:** Contractor must provide an on-site demonstration and training of all systems operations to the Owner when it is substantially completed.

END OF SECTION 01650

SECTION 01700 CONTRACT CLOSE-OUT

1. **Substantial Completion:** The Contractor must notify the Professional, the Project Director and the Agency when the Work will be substantially complete. If the Professional, Owner, and Agency agree that the project is Substantially Complete, the Professional and Project Director will inspect the Work. The Professional, upon determining that the Work, or a portion of the Work inspected, is substantially complete, will prepare a Punch List and will attach it to the respective Certificate of Substantial Completion. The Contractor must be represented on the job site at the time this inspection is made and thereafter must complete all Work by the date set for final acceptance by the Owner.
 - (a) Final completion for final payment will be reached when the punch-list items are completed and all closeout documentation is provided.
2. **Cleaning:**
 - (a) **Regular Cleaning:** The Contractor must remove all scrap or removed material, debris, or rubbish from the Project work site at the end of each working day and more frequently whenever the Owner Field Representative deems such material to be a hazard. The Contractor cannot discard materials on the grounds of the State Agency without the express permission of the Project Director. No salvage or surplus material may be sold on the premises of the State Agency. No burning of debris or rubbish is allowed. Any recyclable materials must be recycled, and the Contractor will be required to provide recycling plan.
 - (b) **Final Cleaning:** Before final acceptance by the State, the Contractor must clean all Work and existing surfaces, building elements and contents that were soiled by their operations and make repairs for any damage or blemish that was caused by the Work.

END OF SECTION 01700

SECTION 01800 MAINTENANCE

1. The Contractor is responsible for maintaining completed portions of the Work in good order and proper working conditions and must take all necessary actions for their protection until substantial completion is reached.

END OF SECTION 01800

Section 01 2200 Unit Prices

Part 1 General

1.01 Scope

- A. This Section describes the method of measurement and basis of payment for all items of Work included in the Contract and specified in the Proposal. CONTRACTOR shall provide labor, material, tools, equipment and services required to complete the Work specified herein and indicated on the Plans.

- B. OWNER WILL MAKE NO ALLOWANCES FOR ITEMS NOT INCLUDED IN THE PROPOSAL.

1.02 Items of the Proposal

Item 1

Furnish and Install Flowmeter and Vault (Day Use Area) will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment required to construct a flowmeter vault in accordance with the Plans. Includes furnishing and installing a new manhole vault over the existing force main and shall include, but is not limited to, excavation, sheeting, shoring and bracing, dewatering, frame and cover, adjusting rings, bottom section, flexible joint connections, sand backfill, crushed gravel base, disposal of excess excavated material, tapping existing force main, furnishing and installing magnetic flowmeter, electrical conduit, wiring and connections, installation of meter readout, valves, valve pit, piping, testing, protection of existing improvements, placing and removing stoppers, bulkheads and flumes, pumping and bypassing flow, removal and disposal of debris, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 2

Furnish and Install Flowmeter(s) and Vault (Visitors Center #2) will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment required to construct a flowmeter vault in accordance with the Plans. Includes furnishing and installing a new manhole vault over the existing force mains and shall include, but is not limited to, excavation, sheeting, shoring and bracing, dewatering, frame and cover, adjusting rings, bottom section, flexible joint connections, sand backfill, crushed gravel base, disposal of excess excavated material, tapping existing force mains, furnishing and installing magnetic flowmeters, electrical conduit, wiring and connections, installation of meter readouts, valves, valve pit, piping, testing, protection of existing improvements, placing and removing stoppers, bulkheads and flumes, pumping and bypassing flow, removal and disposal of debris, and other items necessary to complete the job, whether specifically mentioned or implied.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 8900

Site Construction Performance Requirements

Part 1 General

1.01 Scope of Work

- A. This Section includes general performance requirements for earthwork complete with, reimbursement for crop damage, removal and disposal of structures and obstructions, protection of existing sewers, tiles and mains; protection of existing building and improvements, protection of trees and other types of vegetation, protection of utility lines, requirements for pavement replacement, restoration of driveways and parking areas, restoration of sidewalks, restoration of lawns and disturbed areas, transportation, and disposal of excess excavation.

1.02 Related Work Specified Elsewhere

- A. Section 31 2313: Subgrade Preparation
- B. Section 31 2333: Trenching and Backfilling
- C. Section 32 9219: Seeding

1.03 Reference Standards

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition.

1.04 Requirements of Regulatory Agencies

- A. CONTRACTOR shall comply with all requirements of the National Pollutant Discharge Elimination System (NPDES) Storm Water Program for Construction Activities, Part 31 of PA 451 of 1994 as amended.
- B. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.
 - 1. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

2. Measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.

1.05 Submittals

- A. Written permission for the use of all disposal and borrow sites shall be obtained and copies shall be furnished to ENGINEER.

1.06 Protection of Plant Life

- A. Trees, shrubs, and other types of vegetation not within the limits of the Work or not designated on the Plans or by ENGINEER to be removed, shall be carefully protected from damage or injury during the various construction operations.
- B. Any tree, shrub or other type of vegetation not designated to be removed but which is damaged by CONTRACTOR's operation shall be repaired or replaced by CONTRACTOR, at his expense, as determined by ENGINEER.

1.07 Protection of Existing Structures and Improvements

- A. existing culverts, sewers, drainage structures, manholes, water gate wells, hydrants, water mains, utility poles, overhead lines, underground conduits, underground cables, pavement, or other types of improvements within the construction limits, not designated on the Plans to be removed, shall be carefully protected from damage during the construction operations.
- B. Existing structure or improvement not designated to be removed, but which is damaged by CONTRACTOR's operations shall be repaired or replaced by the CONTRACTOR, to the satisfaction of the owner, at his expense.
- C. Deposits of dirt or debris in sewers, culverts, tiles, drainage structures, manholes, gate wells, etc. caused by CONTRACTOR shall be cleaned out at the CONTRACTOR's expense.

1.08 Maintaining Drainage

- A. Existing open drains, field and roadway ditches, drainage tile, sewers, enclosed drains, natural and artificial watercourses, surface drainage or any other types of drainage within the limits of the Work shall be maintained and free to discharge during construction.
- B. Drainage facility not designated to be abandoned, but which is damaged, or any drainage interrupted by the CONTRACTOR's operation shall be immediately repaired, replaced, or cleared by the CONTRACTOR.
- C. Costs incurred shall be incidental to the excavating, backfilling and compacting or grading operations.

Part 2 Products

2.01 Granular Material

- A. Bank run sand meeting the requirements of MDOT, Granular Material Class II.

2.02 Aggregate for Shoulders, Parking Areas, Driveways or Roads

- A. Crushed Limestone, Natural Aggregate or Slag and meeting the requirements of MDOT Section 902.

Part 3 Execution

3.01 Dewatering

- A. The area within the vicinity of the new Work shall be dewatered prior to commencing any construction activities. The depth of the dewatering shall be sufficient to allow the Work area to remain in a dry condition during the various construction operations.
- B. Costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at CONTRACTOR's expense.

3.02 General

- A. The various construction operations shall be restricted to the existing right-of-way or the areas indicated on the Plans. If CONTRACTOR requires additional area, CONTRACTOR shall furnish the ENGINEER with written permission obtained from the property owner for any part of the operations he conducts outside of the right-of-way or limits indicated.

3.03 Existing Improvements

- A. CONTRACTOR shall expose existing sewers and structures to which the new Work is to be connected and notify ENGINEER of same. ENGINEER will verify the vertical and horizontal locations of the existing system and shall inform CONTRACTOR as to the necessary adjustments required to align the new Work with the existing system.

3.04 Existing Utilities

- A. When existing utilities are shown on the Plans, their locations are approximate only, as secured in the field investigation and/or from available public records. CONTRACTOR, prior to the start of construction, shall contact Miss Dig and the public agency or utility having jurisdiction to request the verification of all utilities within the construction area.
- B. When existing utility lines, structures or utility poles are encountered during the performance of the Work, CONTRACTOR, at his expense, shall perform his operations in such a manner that the service will be uninterrupted.
- C. CONTRACTOR shall expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. CONTRACTOR shall be responsible for any relocation required as a result of any conflict of existing utilities shown on the plans, with the proposed improvement.
- D. Should it become necessary to move any utility structure, line or pole shown on the Plans or otherwise found necessary to be moved, CONTRACTOR shall make all arrangements with OWNER of the utility for the moving. costs incurred for such moving shall be at CONTRACTOR's expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, CONTRACTOR shall furnish ENGINEER with satisfactory evidence, in writing, that proper arrangements have been made with the owner of the utility.

3.05 Utility Poles

- A. CONTRACTOR shall be responsible for any removal or relocation required as a result of any conflict of existing utility poles (including street light poles, guy poles, telephone poles, etc.) with proposed improvements.
- B. CONTRACTOR shall make all arrangements for removing or relocating utility poles with the owner of the utility pole.
- C. Prior to disturbing any utility pole, CONTRACTOR shall provide ENGINEER with written evidence that proper arrangements have been made with the owner of the utility pole.
- D. When required by the Work, CONTRACTOR shall temporarily support poles in the vicinity of the Work at no additional cost to OWNER. Support shall be in accordance with and to the satisfaction of the utility company.

3.06 Existing Sewers, Tile, and Mains

- A. Existing sanitary sewers, storm sewers, drain tile, septic tank bed tiles, water mains or building services or leads, that are encountered during the performance of the Work that require relocation or are damaged, shall be restored with new materials equal in quality and type to the materials encountered.
- B. New material shall be installed as specified in the Contract Documents and per the requirements of the local agencies. Bedding and backfill material, unless otherwise specified, shall be an approved Class II granular material, compacted to 98% of its maximum unit weight.
- C. Seepage bed tile and water mains shall be replaced in accordance with the requirement of the agency having jurisdiction.
- D. Relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall be at CONTRACTOR's expense, unless otherwise indicated in the Contract Documents.

3.07 Existing Structures

- A. Existing surface and subsurface structures may be shown on the Plans, in locations considered most probable from information secured in the field investigation or from available public records.
- B. Neither the correctness nor completeness of such information is guaranteed or implied.
- C. Structures shall be protected, preserved or restored by CONTRACTOR, to the satisfaction of the structure owner, at no additional cost to the Project.

3.08 Existing Buildings

- A. Existing buildings or structures may be encountered throughout the Project within limits of the presently established right-of-way or easement. Good construction methods and procedures shall be employed by CONTRACTOR, at his expense, to protect the structures.
- B. When it becomes necessary for CONTRACTOR to move one of these buildings or structures in order to proceed with construction, CONTRACTOR, at his expense, shall exercise all due care in moving the building or structure to prevent undue damage .

- C. Prior to moving an existing building or structure, CONTRACTOR shall furnish ENGINEER with satisfactory evidence, in writing, that proper arrangements have been made with the owner.
- D. Unless otherwise specified in the Contract Documents, the length of the move shall be maintained to a minimum which will allow for construction of the improvement.

3.09 Removal of Sewers and Culverts

- A. Unless otherwise specified in the Contract Documents, CONTRACTOR, at his expense, shall remove any abandoned culvert, pipe, sewer, structure or part of a structure which is to be replaced or rendered useless by the new construction.
- B. When a sewer or culvert is removed at a structure, CONTRACTOR shall install a masonry bulkhead in the structure.
- C. Removal of a culvert or sewer also includes the removal and disposal of end treatments or headwalls.

3.10 Removal of Structures

- A. Removal of existing structures shall consist of removing and salvaging the existing frame and cover. The ends of the existing pipe shall be plugged and braced. The complete structure shall be removed entirely and disposed of. The excavation shall be backfilled with sand and compacted to 98% of its maximum unit weight. Maximum unit weight shall be determined by ASTM D698, Method B.
- B. If a structure is to be removed from a system that is to remain in service, a bypass system, approved by ENGINEER, shall be installed and maintained by the CONTRACTOR, during the rebuilding period.

3.11 Abandoning Structures

- A. Structure shall be broken down to at least 30 inches (750 mm) below the subgrade.
- B. Pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead approved by ENGINEER.
- C. Structure shall be backfilled with flowable fill to 1-foot (300 mm) above the pipes and the remainder of the structure backfilled with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1-foot (300 mm) below finished grade.
- D. The remainder of the excavation shall be backfilled with a granular material, compacted to 98% of its unit weight, and shall meet with the approval of ENGINEER.
- E. Maximum unit weight shall be determined by ASTM D698, Method B.

3.12 Salvaged Material

- A. Salvaged materials shall become the property of CONTRACTOR unless otherwise specified in the Contract Documents, and shall be disposed of by CONTRACTOR, at his expense.

3.13 Crop Damage

- A. In areas where crops are encountered along the route of the construction, a written agreement shall be arrived at by CONTRACTOR and the crop owner as to the type and nature of the crop concerned prior to any construction within the area.
- B. CONTRACTOR shall be responsible for making full reimbursement to the owner of the crop damage on the basis of the following procedure:
 - 1. Area of the crop damage shall be determined by measurements taken by ENGINEER, and this area shall include those portions of the crop which may extend into the public right-of-way.
 - 2. Average yield of the crop shall be established by the County Office of the U.S. Agricultural Extension Service.
 - 3. Cost of the crop shall be determined by using the prevailing price at the time of harvest as furnished by the U.S. Agricultural Extension Service.
- C. CONTRACTOR shall furnish ENGINEER with satisfactory evidence that payment for crop damage was made, prior to receiving final payment on the Project.

3.14 Trees

- A. Trees excepting those specified on the Plans to be removed, shall be effectively protected by CONTRACTOR during his construction operations.
 - 1. If in the opinion of ENGINEER, the methods of protection employed by CONTRACTOR are not adequate, CONTRACTOR shall carry on his operation by tunneling, or by other approved means, which will not cause undue damage to the trees.
- B. The requirements for tree tunneling are as follows:
 - 1. Depth of Cover:
 - a. Tunnels shall be placed at a minimum depth of 30 inches (0.75 m), measured from the ground surface to the top of the tunnel.
 - 2. Length of Tunnel:
 - a. Tunnel length in feet (meters) shall be in direct proportion to diameter of tree in inches (millimeters) for trees eight (8) inches (200 mm) or larger in diameter. One (1) foot of tunnel shall be constructed for each inch of tree diameter whenever the trench or any portion thereof approaches the tree trunk a distance in feet equal to one-half the tree diameter in inches.
 - b. Example: A tree 12 inches in diameter shall require a 12-foot tunnel whenever the trench or any portion thereof approaches within six (6) feet of said tree.
 - 3. Measurements:

- a. Trees under 8 inches in diameter will require the same length of tunnel as 8-inch trees. Measurements of tree diameters shall be taken four (4) feet above the ground surface.
- C. Where the Plans indicate areas allowing the cutting of minor trees, care should be used to keep damage to adjacent trees to an absolute minimum. Where these areas are specifically indicated on the Plan, they are to be cleared and all trunks and branches shall be disposed of by CONTRACTOR. Debris shall not be bulldozed on to adjacent private property.
- D. Trees damaged by the construction operation shall be repaired so not to inhibit growth or replaced at the expense of CONTRACTOR. Repair or replacement shall be contingent upon agreement between the damaged tree owner and CONTRACTOR. In any event, limbs, branches and roots damaged by CONTRACTOR shall be properly pruned to the satisfaction of ENGINEER.
- E. Costs incurred for protection of trees, including tunneling, repair and replacement, if necessary, shall be at CONTRACTOR's expense.

3.15 Remove and Replace Tree

- A. Tree removal and replacement may be accomplished in two ways:
 - 1. CONTRACTOR may completely remove and dispose of the existing trees, and after the new improvement has been completed, tested, accepted and rough grading has been completed, CONTRACTOR shall plant new trees, in approximately the same location as the existing trees, of size and species per the following (existing trees to be replaced with like specie):
 - a. "Acer Rubrum" October Glory Red Maple, 2 ½-inch B&B (min)
 - b. "Malus Centzam" Centzam Crabapple, 2-inch B&B (min)
 - c. "Crataegus Phaenaopyrum" Washington Hawthorn, 8-foot B&B (min)
 - d. "Pinus Nigra" Austrian Pine, 6-foot B&B (min)
 - e. "Picea Pungens" Colorado Spruce, 5-foot B&B (min)
 - f. "Quercus Rubra" Red Oak, 2 ½-inch B&B (min)
 - g. "Pyrus Calleryana" Redspire Pear, 2-inch B&B (min)
 - 2. CONTRACTOR may remove and preserve the existing trees.
 - a. The trees shall be properly cared for and maintained in a healthy condition.
 - b. After the new improvement has been installed, tested, accepted and rough grading completed, the trees shall be replanted in approximately the same location. Any trees damaged, destroyed or which die, shall be replaced at no additional cost.
- B. Trees, whether replanted or planted new, shall be guaranteed for a period of two years from the date of substantial completion.

3.16 Removing Pavement

- A. Removal of concrete and bituminous pavement as called for on the Plans shall consist of removing and disposing of pavement and shall include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.
- B. Pavement shall be removed to an existing joint or cut parallel to the existing pavement joints.
- C. Cutting shall be accomplished by using a power-driven concrete saw approved by ENGINEER. Depth of the saw cut shall be a minimum of 6-inches, to insure that the removal of the old pavement will not disturb or damage the section of pavement remaining in place.
- D. Residual concrete pavement shall not be less than five feet measured transversely, nor less than 6 feet longitudinally measured from a joint.
- E. In removing a concrete base course, where part of the existing bituminous surface is to remain in place, the bituminous surface shall be cut the full depth by the use of a power-driven saw, approved by ENGINEER along a line parallel to and at least one foot from either side of the base course removal.
- F. Old pavement with a concrete cap shall be considered as only one (1) pavement, whether or not there is a separation layer of earth, aggregate, or bituminous material between the old material and the concrete cap.
 - 1. Removal of Curb for Curb Drop:
 - a. Where curb is to be removed for a curb drop, the operation shall be performed by saw cutting or by cold milling, approved by ENGINEER, so as to leave a neat surface with a maximum 1-inch lip, without damage to the underlying pavement.
 - 2. Removal of Curb and Gutter:
 - a. Where curb and gutter are to be removed, the operation shall be performed by saw cutting. The limits of the removal shall be as called for on the Plans, or as approved by ENGINEER. However, in no case shall the width of removal be less than 18 inches for sections with rolled or straight curb or less than 24 inches for mountable curbs.
- G. If during the pavement removal operation any concrete or bituminous pavement or surfacing is damaged beyond the removal limits designated, the damaged pavement or surfacing shall be removed and replaced at CONTRACTOR's expense.
- H. Earth which may be removed during the pavement removal operation shall be replaced by backfilling to the proposed subgrade with a suitable material, approved by ENGINEER, at CONTRACTOR's expense.

3.17 Guardrail

- A. Beam guardrail shall be relocated or shall be removed as specified on the Plans or as determined by ENGINEER. If any of the existing material is damaged or destroyed, CONTRACTOR shall replace the material at his expense.

- B. Where guardrail is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at CONTRACTOR's expense, to a condition comparable to that prior to construction.
- C. After the guardrail removal or relocation operations are complete, all surplus material shall be removed and disposed of by CONTRACTOR, at his expense, unless otherwise called for in the Contract Documents.
- D. Any holes or voids resulting from the guardrail removal operation shall be backfilled with a Class II granular material, approved by ENGINEER.

3.18 Fences

- A. Fences shall be removed and replaced or shall be removed as indicated on the Plans. If any of the existing material is damaged or destroyed, CONTRACTOR shall replace the material at his expense.
- B. Where fencing is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at CONTRACTOR's expense, to a condition comparable to that prior to construction.
- C. After the fence removal or relocation operations are complete, all surplus material shall be removed and disposed of by CONTRACTOR, at his expense, unless otherwise called for in the Contract Documents.
- D. Any holes or voids resulting from the fence removal operation shall be backfilled with a suitable material, approved by ENGINEER.
- E. Where fences are encountered that are being used to confine livestock or to provide security, the fence shall be immediately replaced following construction. During construction, CONTRACTOR, at his expense, shall provide, install and maintain a temporary fence, meeting the approval of ENGINEER.

3.19 Holes

- A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material. Material shall be placed by the controlled density method or other effective means having the approval of ENGINEER and shall be compacted to 95% of maximum unit weight.
- B. Furnishing, placing and compacting of the backfill material shall be at CONTRACTOR's expense.

3.20 Restoration in Right-of-Way and Yard Areas

- A. Right-of-way and yard areas not paved or aggregate surfaced shall be restored in accordance with the type and location specified herein unless indicated otherwise on the Plans. Disturbed areas may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans. Areas where slopes are 1 on 4 or flatter shall be restored with topsoil, seed and mulch. Slopes steeper than 1 on 4 shall be restored with sod.
- B. Excess material from the restoration operation shall be disposed of by CONTRACTOR at his expense.

- C. Disturbed areas shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding, or Section 32 9223, Sodding.
- D. CONTRACTOR, at his expense, shall furnish, place, and compact any additional fill, meeting the approval of ENGINEER, needed to restore the disturbed areas to the cross sections called for on the Plans or as determined by ENGINEER.

3.21 Restoration of Aggregate Surfaces

A. Shoulders:

- 1. Shoulder shall be regarded as the area between the edge of pavement and the ditch, or the area within 10 feet of the pavement, whichever is the lesser.
- 2. Backfilling of trenches in the shoulder area shall be carried to within 5 inches of the existing surface as specified under Trench "A" or Trench "B." The remaining depth shall be backfilled with a minimum of 5 inches of compacted 22A or 23A aggregate with calcium chloride applied, at the rate of 6 pounds per Ton of aggregate .
- 3. CONTRACTOR, at his expense, shall furnish, place and compact all materials necessary to complete the backfilling and restoration operation within the shoulder area.

B. Driveways and Parking Areas:

- 1. Aggregate driveway areas shall be regarded as the area from the right-of-way line to the edge of the traveled roadway and shall include the shoulder area.
- 2. Backfilling of trenches crossing aggregate surfaced driveways and parking areas shall be carried to the bottom of the proposed base course as specified under Trench "B". The remaining depth shall be backfilled with a minimum of 6 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate.
- 3. Aggregate surfaced areas beyond the limits of the actual excavation which are disturbed, as determined by ENGINEER, by such operations as temporary storage of materials or passage of equipment, shall be resurfaced, at CONTRACTOR's expense.
 - a. Upper 3 inches of disturbed areas shall be removed as necessary to allow the final elevation of the resurfacing course to be at the elevation of the drive or parking area which existed prior to excavation.
 - b. Disturbed area shall be resurfaced with a minimum of 3 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate
- 4. CONTRACTOR, at his expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the driveway and parking area.

C. Roads and Streets:

1. Backfilling of trenches crossing aggregate surfaced roads or streets shall be carried to within 12 inches of the existing surface as specified under Trench "B." The remaining depth shall be backfilled with two 6-inch layers of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate.
2. CONTRACTOR, at his expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the roadway or street area.
3. Also, any settlement of the aggregate surface shall be restored by placing additional aggregate, up to the original grade, and shall be done at the CONTRACTOR's expense.

D. Compaction:

1. Compaction of all aggregate shall be performed by a pneumatic-tired roller or a vibratory compactor until the material forms a stable surface.

3.22 Restoration of Paved Surfaces

- A. CONTRACTOR, at his expense, shall provide the materials necessary to complete the backfilling and restoration operations, which shall include furnishing, compacting, forming, placing, rolling, floating, jointing, finishing, curing and providing protection against elements.
- B. Restoration of any roadways that are partially damaged shall include a minimum replacement of one (1), full width lane of roadway. The length of replacement shall be at least equal to the width.
- C. Concrete:
 1. Backfilling of trenches crossing concrete driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the proposed pavement as specified under Trench "B"
 2. Unless otherwise specified on the Plans or as determined by ENGINEER, the concrete removed shall be replaced with 3,500 psi concrete of the thickness removed and shall include reinforcing equal to the existing, if the existing pavement was reinforced.
 - a. The construction of concrete pavements shall be in accordance with Section 32 1313, Concrete Paving.
 3. Restoration of sidewalks shall also include the construction of sidewalk ramps at the intersection of the curb and shall conform to the current rules and regulations of Act 8, Michigan PA 1973, as amended and to Section 32 1315, Sidewalks and Driveways, and unless otherwise indicated in the Proposal, shall be considered incidental to the Project.

D. Bituminous:

1. Backfilling of trenches crossing bituminous driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the base course as specified under Trench "B."
2. Bituminous pavement or bituminous surface course with an aggregate base shall be replaced in accordance with Section 32 1216, Bituminous Paving.
3. Bituminous surfaced areas beyond the limits of the actual excavation which are disturbed by such operations, as temporary storage of materials or passage of equipment, shall be resurfaced with an approved bituminous mixture the same thickness as removed, but in no case less than 2 inches in thickness. Replacement material shall extend to smooth-cut edges, shall be uniform in direction and shall be at an elevation which provides a uniform surface between the undisturbed abutting surfaces.
4. Restoration of any bituminous chip seal shoulders that are damaged or partially damaged, as determined by ENGINEER, shall include complete replacement full width and length (extending a minimum of 25 linear feet beyond the damaged area both ways). Existing bituminous chip seal shoulders shall be brought to proper grade with compacted 22A or 23A aggregate and resurfaced with a double chip seal per Section 32 1216, Bituminous Paving.

3.23 Soil Erosion and Sedimentation Control

- A. CONTRACTOR shall comply with the requirements of Section 01 5713, Temporary Erosion and Sediment Control. Prior to commencing any type of earthwork, CONTRACTOR shall obtain a Soil Erosion and Sedimentation Control permit from the local enforcing Agency.
- B. CONTRACTOR, at his expense, shall obtain all approvals, secure all permits and post all bonds and deposits required to comply with the Soil Erosion and Sedimentation Control Act, Part 91 of PA 451 of 1994, as amended, and those of the enforcing agency.
- C. CONTRACTOR shall provide ENGINEER with a copy of the soil erosion permit issued by the local enforcing agency for the Project, prior to commencing any type of earthwork on the Project.

3.24 Excess Excavation

- A. Excess excavation shall be defined as all surplus earth material realized from the construction that is free of brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material.
- B. CONTRACTOR, when requested by OWNER, shall transport all excess excavation to a site(s) designated by OWNER.
 1. Excess excavation shall be graded by CONTRACTOR to provide positive surface drainage of the site(s).
 2. Grading shall be done such that adjacent properties are not damaged or affected. The grading shall include removal of all surface irregularities to provide a smooth surface (\pm 0.25 foot).

- C. When the excess excavation has not been requested by the OWNER, CONTRACTOR shall remove and properly dispose of the material at no additional cost to OWNER.
- D. Proper disposal of all excess excavation, including transportation, grading, and protection of adjacent properties shall be considered as a final cleanup item. No additional payment will be made for this item.
- E. Brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material from the construction shall become the property of CONTRACTOR, and shall be disposed of per all applicable Laws, rules or regulations. Removal and disposal of this material shall be considered as part of final cleanup. No additional payment will be made for this item.
- F. OWNER approval of the final site(s) condition in writing will be required prior to final payment authorization.

End of Section

Division 04
Masonry

Section 04 0511

Mortaring and Grouting

Part 1 General

1.01 Scope of Work

- A. This Section includes the preparation and installation of mortar and grout used for bond or primer coats, laying and grouting masonry units, filling the inside annular space of pipe joints, general patching, grout for riprap and flagstone slope protection, joints in precast structural members, spaces under leveling plates and equipment bases, supporting structures, grouting dowels and anchor bolts.

1.02 Definitions

- A. Mortar is a plastic mixture of cementitious materials, admixtures where specified, fine aggregate and water. Grout is a mixture of sand, water, and fine aggregate mixed to a fluid consistency.

1.03 Reference Standards

- A. ACI - American Concrete Institute
- B. ANSI - American National Standards Institute
- C. ASTM - American Society for Testing and Materials
- D. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Reference Specifications

- A. Latest or current ACI Standards, and the "Specifications for Masonry Structures," ACI-530.1, shall govern mortar and grout work except where otherwise specified herein.

1.05 Submittals

- A. Manufacturer's literature shall be submitted for premixed materials.

1.06 Product Delivery, Storage, and Handling

- A. Materials shall be stored and handled as recommended in ACI 304.
- B. When cement is stored in the open, a floor at least six (6) inches (150 mm) above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain. At the time of its use the cement shall be free from lumps. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by CONTRACTOR by cleaning sacks mechanically or otherwise, or from discarded sacks of cement shall not be used.
- C. Aggregates are to be furnished, stocked and handled so that uniformity of grading will be obtained at the time of batching. The area on which stockpiles are to be built shall be thoroughly cleaned of all foreign materials and shall be firm, reasonably level, and well drained. No aggregates which have become intermixed prior to proportioning shall be used.

- D. The premixed mortar or grout shall be stored and handled in strict accordance with the manufacturer's recommendations.

1.07 Job Conditions

- A. Environmental requirements relative to temperature for mixing and placing mortar or grout shall be in accordance with Articles 2.08 and 3.08 of this Section.

Part 2 Products

2.01 Premixed Mortar or Grout

- A. Premixed mortar or grout shall be a complete packaged mixture to which water is to be added at the job site. Mortar and grout shall be nonshrink, nonstaining.

2.02 Cement

- A. The type of cement to be used shall be as indicated on the Plans or as specified below:
 1. Portland cement: Types I, IA or III: ASTM C150.
 2. Masonry cement: Type N, S, or M: ASTM C91.
 3. Mortar: Type M or S: ASTM C270.
 4. Hydrated lime: Type S: ASTM C207.

2.03 Aggregate

- A. Fine aggregate: Type 2MS, per MDOT Section 902.08.

2.04 Admixtures

- A. Integral waterproofing compounds, accelerators, retarders or other admixtures not definitely mentioned in the Specifications shall not be used in mortar or grout without the approval of the ENGINEER. Use no admixtures containing calcium chloride.

2.05 Water

- A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the State Board of Health may be used without testing. Water from other sources shall be tested before using.

2.06 Mixes

- A. General:
 1. Water shall be added to premixed mortar or grout in strict accordance with manufacturer's recommendations to prepare a stiff or plastic mix, depending on workability needed for application.
 2. For job mixed mortar or grout, a mixture of cement, aggregate, water and admixtures, if required, shall be combined in proportions meeting the requirements of MDOT Section 702 to produce mortar or grout for the use indicated on the Plans and as specified herein.

3. For job mixed mortar and grout the cement and aggregate shall be proportioned by weight for cubic yard (or cubic meter) batches or by volume for small batches. Shovel method of volume measuring will not be permitted. When materials are measured by volume, water shall be added in amounts necessary for the consistency required for the Work.

B. Standard Mortar and Grout:

MDOT Designation	General Use
R-1 (Grout)	Bond or Primer Coat
R-2 (Mortar)	Laying masonry units, caulking pipe joints, general patching
R-3 (Mortar)	Filler between slope protection and riprap

C. Nonshrinking Mortar and Grout:

1. Unless otherwise indicated on the Plans or Specifications, the cement shall be Portland Type I. The materials shall be proportioned by weight, with water added in amounts to obtain necessary consistency required for the Work.

MDOT Designation	General Use
Type H-1	Joints in precast structural members
Type H-2	Spaces under leveling plates, supporting structures, grouting dowels, anchor bolts

2.07 Mixing

- A. Minimum mixing time shall be five (5) minutes. Consistency of mortar shall be adjusted to provide the best workability. If the mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be retempered by adding water and remixing. Consistency of the grout shall be such that at the time of placement, it will completely fill all spaces intended to receive grout.

2.08 Mix Temperature

- A. The temperature of the mix shall be between 40 degrees and 120 degrees Fahrenheit (4 degrees to 49 degrees Celsius).

2.09 Acceptable Manufacturers

- A. Acceptable manufacturers of premixed, nonshrink, nonmetallic grout include: Sonneborn "SonogROUT"; L and M Construction Chemicals "DuragROUT"; Master Builders "Masterflow 713"; Five Star Products "Five Star Grout", or equal.

Part 3 Execution

3.01 Contractor's Verification

- A. CONTRACTOR shall verify the elevation of structural member or equipment bases to be grouted, and/or location of anchoring devices as indicated on the Plans or approved Shop Drawings.

3.02 Preparation

- A. Surfaces to receive mortar or grout shall be prepared as follows, unless otherwise specified:
 - 1. Remove laitance down to sound concrete.
 - 2. Surface shall be properly wet cured, being free of chemical curing compound, oil, grease, dirt and loose particles.
 - 3. Clean bolt and/or tie holes, anchor bolts and underside of bearing plates.
 - 4. Saturate concrete including holes prior to grouting.
- B. When a premixed mortar or grout is used, preparation of surfaces shall be in strict accordance with manufacturer's recommendations.

3.03 Installation - General

- A. All mortar and grout shall be used within 2-1/2 hours of initial mixing. No mortar or grout shall be used after it has begun to set.
- B. Premixed mortar or grout shall be used in strict accordance with the manufacturer's recommendations.

3.04 Installation of Masonry Units

- A. Mortar joints to bond brick or block shall be no less than 3/8 inch (9 mm) and no greater than 1/2 inch (10 mm) thick. Surface of the joint shall be struck to be flush with the masonry units.

3.05 Surface Finishing Applications

- A. Nonshrink mortar shall be thoroughly compacted into all voids, holes, honeycombs, or other defects in the finish surface of concrete. Mortar shall be flush with the surrounding concrete and matching in color and texture.

3.06 Grouting Anchoring Devices

- A. Nonshrink, nonstaining mortar or grout shall be placed in the hole provided, then the anchoring device or dowel shall be set into the grout filled hole. Surface shall be flush with the surrounding concrete. No pressures or loads shall be applied to the anchoring device until the mortar or grout has attained its ultimate strength.

3.07 Grouting Plates and Structural Members

- A. Thoroughly fill the area between the foundation and plate or member with nonshrink, nonmetallic grout. If required, immediately set shims and align plate or member as required. After the grout has set hard remove forms or shims and finish with a capping mortar.

3.08 Cold Weather Work

- A. General:

1. No masonry units, mortar or grout Work shall be placed in contact with frozen surfaces. No mortar or grout Work shall be performed when the mean air temperature is below 40 degrees Fahrenheit (4 degrees Celsius) unless the materials are heated and/or CONTRACTOR provides adequate protection of the Work. Work shall be protected against freezing for no less than 48 hours after placement.
 2. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.
- B. Air Temperature 40 degrees to 32 degrees Fahrenheit (4 to 0 degrees Celsius):
1. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Heating of either of the ingredients shall be to a minimum 70 degrees and maximum 160 degrees Fahrenheit (21 to 71 degrees Celsius). Ideal mortar temperature should be 70 degrees to 80 degrees Fahrenheit (21 to 27 degrees Celsius).
- C. Air Temperature 32 degrees to 25 degrees Fahrenheit (0 to -4 degrees Celsius):
1. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Maintain temperatures of mortar on boards above freezing. Heat sand and water to a minimum 70 degrees and maximum 160 degrees Fahrenheit (21 to 71 degrees Celsius).
- D. Air Temperature 25 degrees to 20 degrees Fahrenheit (-4 to -7 degrees Celsius):
1. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Maintain mortar temperatures on boards above freezing. Salamanders or other sources of heat shall be used on both sides of interior bearing walls under construction and on the inside of all exterior walls. Windbreaks shall be employed when wind is in excess of 15 mph (24 kph).
- E. Air Temperature 20 degrees Fahrenheit (-7 degrees Celsius) and Below:
1. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees Fahrenheit (0 degrees Celsius). Temperature of units when laid shall be not less than 20 degrees Fahrenheit (-7 degrees Celsius).

End of Section

**Division 31
Earthwork**

Section 31 2313 Subgrade Preparation

Part 1 General

1.01 Scope of Work

- A. This Section includes preparing subgrade for pavement construction complete with excavation, embankments, proof rolling, subgrade undercut and backfill, subgrade stabilization fabric, subbase, right-of-way ditching, right-of-way restoration, field quality control, and appurtenances.

1.02 Related Work Specified Elsewhere

- A. Section 01 2200: Unit Prices
- B. Section 01 8900: Site Construction Performance Requirements
- C. Section 32 9219: Seeding

1.03 Reference Standards

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM - ASTM International
 - 2. AASHTO - American Association of State Highways and Transportation Officials
 - 3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

- A. Finish subgrade surface shall be shaped to conform to plan grade and cross section within a tolerance of one-inch (25 mm) in ten (10) feet (3.0 m).

1.05 Submittals

- A. Test Reports:
 - 1. Testing lab shall provide ENGINEER with two (2) certified copies of the sieve analysis of the backfill material.
 - 2. Testing of the material and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

3. Testing lab shall provide ENGINEER with two (2) certified copies of the compaction and moisture tests of the backfill and subgrade materials.
 4. Testing of the materials and the certification of the test results shall be performed by a testing laboratory approved by the ENGINEER.
- B. Samples:
1. Submit sample of the proposed subgrade stabilization fabric measuring not less than 1 yd² (1 m²) in area, and the manufacturer's certification that the proposed fabric meets or exceeds all requirements listed in Article 2.03 of this Section.
 2. Submissions shall be made not later than 10 working days prior to any installation.

1.06 Product Delivery Storage and Handling

- A. Geotextile fabric shall be furnished and stored in a wrap that will protect the geotextile from ultraviolet radiation and abrasion.
- B. Geotextile shall be covered with the aggregate base as per plan within two (2) weeks of its placement.

1.07 Soil Erosion and Sedimentation Control

- A. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.
- B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.
- C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.
- D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Granular Materials

- A. Granular material gradation shall conform to the grading requirements for granular material Class II as specified in MDOT, Section 902.08.

2.02 Aggregate Materials

- A. Aggregate materials, used for undercut backfill shall be crushed limestone, natural aggregate, blast furnace slag, or crushed concrete, meeting the requirements of 21AA, 21A or 22A as specified in MDOT Section 902.06.
- B. Crushed concrete shall be free of all steel and other deleterious materials.

2.03 Subgrade Stabilization Fabric

- A. Subgrade stabilization fabric shall be composed of synthetic fibers formed into a woven fabric. The fibers shall be composed of 85% propylene or ester polymers. The geotextile shall conform to the following requirements listed below:

Property	Test Procedure	Test Result
Grab Tensile	ASTM D4632	270 lbs. (min)
Elongation	ASTM D4632	15% (min)
Trapezoidal Tear	ASTM D4533	100 lbs. (min)
CBR Puncture Strength	ASTM D6241	900 lbs. (min)
Apparent Opening Size	ASTM D4751	40 – 70 U.S. Sieve
Permittivity	ASTM D4491	0.05 per sec (min)

Part 3 Execution

3.01 Removing Structures

- A. Structures and sewers to be removed shall be called for on the Plans or as determined by ENGINEER. Removal or abandonment of structures shall be in accordance with Section 01 8900, Site Construction Performance Requirements.

3.02 Holes

- A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material approved by ENGINEER.
- B. Material shall be compacted to 95% of its maximum unit weight.
- C. Furnishing, placing and compacting of the backfill material shall be at CONTRACTOR's expense.

3.03 Salvaging and Stockpiling Topsoil

- A. Topsoil, within the grading limits for cuts, and where the fill is less than five (5) feet (1.5 m) in height to the top of proposed road, shall be removed to a depth and width specified on the Plans.
- B. Topsoil from peat and muck areas shall not be removed.
- C. Topsoil salvaged in excess of that required by the Plans will be disposed of by the CONTRACTOR at his expense.
- D. Removing and salvaging topsoil shall be in accordance with Section 31 2200, Grading.

3.04 Preparing Roadway Subgrade

- A. Muck, peat and other unsuitable material within the roadway shall be removed, displaced or otherwise treated, as shown on the Plans or as directed by ENGINEER.
- B. Deposits of frost heave material within lines two (2) feet (0.6 m) outside the proposed roadbed shall be removed to a depth of three (3) feet (0.9 m) below the surface of the earth grade, unless otherwise shown on the Plans or as determined by ENGINEER.

- C. Ice and snow shall be removed from the surface of the ground before the embankment is placed.
- D. Muck, peat, frost heave material and other unsuitable material shall be disposed of outside the highway limits or shall be spread uniformly in low places beyond the roadway limits when so approved by ENGINEER.
- E. Old road surfacing or gravel, crushed stone, or other nonrigid type surfacing, occurring within the area of the roadbed and underlying proposed embankment less than 1-foot in depth, and which is not to be salvaged and incorporated in the new Work, shall be plowed or scarified full depth, spread and compacted to form a uniform foundation, before any new embankment is placed.
- F. Old pavement and other rigid structures, occurring within the area of the roadbed and underlying the proposed embankment less than 1-foot in depth and which are not to be incorporated into the new Work, shall be broken up and removed.

3.05 Subgrade

- A. Area to be paved shall be excavated and smoothed to the line, grade and cross section as indicated on the Plans.
- B. Subgrade between the lines two (2) feet (0.6 m) on either side of the proposed edge of pavement or curb shall be compacted to 95% of the maximum unit weight for a depth of seven (7) inches (175 mm), by rolling with a roller weighing not less than ten (10) tons (9000 kg).
- C. Subgrade shall be completed ahead of placing forms or paving a distance equal to the distance of one day's average paving operation. Prior to the paving operation, the subgrade shall be shaped and compacted to the Plan cross section by approved mechanical means.

3.06 Pavement Excavation

- A. Pavement excavation shall consist of all Work required to construct the earth grade and its appurtenances true to the lines, grades, and cross sections called for on the Plans and in accordance with these Specifications.
- B. Excavation shall consist of the following items, any of which or all of which may be included or incidental to it; removing trees, stumps, hedges, roots, culverts, sewers, miscellaneous structures, roadway excavation, removing of all asphalt or concrete pavements, curbs, curb and gutters, sidewalks, end headers, removing aggregate surfaces, salvaging and stockpiling topsoil, subgrade undercut, excavation for structures, trimming and finishing earth grade, fine grading, right-of-way ditching and restoration, and the disposal of all unsuitable material.
- C. Large stones, trees, stumps, brush, shrubs, logs, matted roots, other vegetation and debris occurring between lines three (3) feet (0.9 m) outside the grading limits or as otherwise shown on the Plans shall be completely removed and properly disposed of as specified in Section 31 1100, Clearing and Grubbing.
- D. Earth and other existing materials shall be excavated for the full depth and width of the cross section as shown on the Plans. Material shall be excavated sufficiently for setting of forms or slip-form equipment. Excavation shall be limited to 3,000 linear feet (900 m) of right-of-way unless additional lengths are requested in writing and approved by ENGINEER.

- E. Excess excavated material shall be removed from the project by CONTRACTOR along approved routes to disposal sites approved by OWNER. Disposal of excess excavation and maintenance of the dump sites shall be considered incidental to the price paid for excavation and shall be as specified in Section 01 8900, Site Construction Performance Requirements.

3.07 Borrow Excavation

- A. Materials which are secured from locations outside of the project limits for the purpose of completing embankments and other items, will be considered as borrow excavation.
- B. Borrow pits and the materials to be removed therefrom shall be subject to the inspection of ENGINEER and shall be secured by CONTRACTOR, unless otherwise provided.
- C. Borrow excavation will be measured by volume in cubic yards compacted in place, based on the neat lines called for on the Plans or as authorized by ENGINEER. To facilitate the accurate measurement of borrow quantities, unless otherwise specified in the Contract Documents, CONTRACTOR shall perform all the regular excavation and grading with existing materials for any designated area and ENGINEER will cross section these areas prior to CONTRACTOR furnishing and placing the required borrow material. ENGINEER will then resection the completed area and compute the volume of borrow material in its compacted-in-place state. Any borrow material placed beyond the neat lines called for on the Plans or which is not authorized by ENGINEER in writing will not be measured and computed as borrow excavations. Measurement of borrow material by truck count will not be acceptable.
- D. Public and private roads used by CONTRACTOR between the source of borrow and the Project shall be maintained by CONTRACTOR, at his expense, including repairs of any damage caused by his operations. Also included is the application of a dust palliative when necessary, as determined by ENGINEER.

3.08 Embankments

- A. Embankments shall be constructed with sound earth. Materials shall be deposited and compacted by either the Twelve Inch Layer Method, or the Controlled Density Method. The Controlled Density Method will be required unless the twelve inch layer method or some other method is specifically called for on the Plans.
- B. Topsoil shall be stripped from the entire fill area. Depth of the topsoil to be removed shall be as shown on the Plans or as determined by ENGINEER. After the topsoil is removed, the entire area upon which the embankment is to be constructed shall be compacted to not less than 90% of the maximum unit weight, to a depth of nine (9) inches (225 mm).
- C. Where stones are prevalent, the material shall be carefully placed so that all large stones will be well distributed and the crevices completely filled with smaller stones, earth, sand or gravel so as to form a solid embankment. Rock or fragmental material of such size as would prohibit it from being placed in layers of the specified depth shall not be placed in the embankment. In no case shall stones over three (3) inches (75 mm) in diameter be placed within 12 inches (300 mm) of the surface of the earth grade within the areas between lines two (2) feet (0.6 m) outside of the edges of proposed roadbed.
- D. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

- E. Construction requirements for the two (2) methods of placing and compacting embankments are as follows:
1. Twelve-Inch Layer Method:
 - a. Material shall be deposited and spread in layers not more than 12 inches (300 mm) in depth, loose measure, parallel to the finished grade and extending to the full width of the embankment. Material shall be deposited by operating the conveying equipment over the layer being placed, insofar as feasible.
 - b. Each layer shall be compacted to not less than 95% of the maximum unit weight as determined at the existing moisture content. Operation of compacting shall be continued until each layer is compacted to the required density for its full width.
 2. Controlled Density Method:
 - a. Material for the embankment shall be deposited and spread in layers not more than nine (9) inches (225 mm) in depth, loose measure, and extending to the full width of the embankment, except that granular material may be spread and compacted in layers not more than 15 inches (375 mm) in thickness if the specified density is obtained.
 - b. Material for embankments of five (5) feet (1.5 m) or less and the bottom four (4) feet (1.2 m) of embankments of more than four (4) feet (1.2 m) above the surface of the ground upon which the embankment is to be constructed shall have not more than the optimum moisture content at the time of compaction.
 - c. Material for that part of the embankment more than five (5) feet (1.5 m) above the surface of the ground upon which the embankment is to be constructed shall have a moisture content of not greater than three (3) percent above optimum at the time of compaction, except that the moisture content of the top three feet (0.9 m) of the embankment shall not exceed optimum. If granular material is used to construct the embankment, it shall be at a moisture content below saturation.
- F. If the material contains an excess of moisture, it shall be dried to the required moisture content before being compacted.
- G. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of its maximum unit weight, unless otherwise specified, before the succeeding layer is started.
- H. When the original ground upon which the embankment is being placed, or any section of compacted embankment, or the soil in cut sections becomes rutted or distorted by CONTRACTOR's equipment, the method of operation shall be changed to eliminate this condition. CONTRACTOR shall reshape and recompact any areas so rutted or distorted at his own expense. This shall be done before any succeeding layers are placed.

3.09 Rough Grading

- A. CONTRACTOR shall rough grade as close as possible to finished subgrade leaving a minimum to be removed in fine grading.

- B. Excavated material removed during grading and stored along the line of Work between curb and sidewalk on improved lawns shall not be left longer than 48 hours. Lawns or otherwise improved areas shall be left in a neat and clean state within the specified 48 hours.
- C. During the excavation operation, including the placing of the subbase, the Work area shall be kept free of water. A dewatering system shall be provided and maintained by CONTRACTOR at his expense. The dewatering system shall remain in operation until the paving is completed.

3.10 Proof Rolling

- A. After removal of topsoil or other overburden and after construction of embankments, proof roll the existing subgrade with six passes of a minimum 15 ton pneumatic-tired roller. Operate the roller in a systematic manner to assure the number of passes over all areas, and at speeds between 2.5 and 3.5 miles per hour. When proof rolling under structures, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes.
- B. Proof rolling shall be done in the presence of ENGINEER. Rutting or pumping shall indicate unsatisfactory material and that material shall be undercut as determined by ENGINEER, and replaced with the appropriate fill material.
- C. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades. Materials degraded by proof rolling a wet or saturated subgrade shall be replaced by CONTRACTOR as determined by ENGINEER at no cost to OWNER. Notify ENGINEER 3 days prior to proof rolling.

3.11 Subgrade Undercut Excavation

- A. Unsuitable subgrade excavation shall be the operation of:
 - 1. removing unsuitable soils as determined by ENGINEER, below the level of the ground after topsoil has been stripped in fill areas where the embankment is to be five (5) feet (1.5 m) or less in height to plan grade, or
 - 2. the removal of unsuitable soils below the subgrade elevation, as determined by ENGINEER in cut areas after the subgrade has been established.
- B. In fill areas, after topsoil has been stripped in accordance with Article 3.03 of this Section, ENGINEER will inspect the embankment area to certify the adequacy of the native soils and to determine the extent of any additional excavation of unsuitable soils prior to placing the first lift of the embankment.
- C. In cut areas after the subgrade elevation has been established by the mass grading operation, ENGINEER will inspect the subgrade to determine the extent of any additional excavation of unsuitable soils.
- D. The areas excavated of unsuitable material, unless otherwise specified in the Contract Documents, shall be backfilled with nonfrost heaving material similar to the adjacent soil. However, in areas as determined by ENGINEER where free water due to seepage is present, the excavation shall be backfilled with Granular Material, Class II, and drainage shall be provided. Backfill shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified.

3.12 Subgrade Stabilization Fabric

- A. Place Subgrade Stabilization Fabric on prepared subgrade or subbase in the manner and at the location as called for on the plans. Fabric shall be laid smooth and free of tension stress, wrinkles or creases.
- B. Fabric strips shall be placed to provide a minimum overlap of 24 inches (600 mm) for each joint.
- C. Fabric shall be placed so that the upper strip will overlap the next lower strip.
- D. Should the geotextile be damaged during construction, the torn or punctured section shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus two feet (0.6 m) to adjacent undamaged geotextile in all directions.

3.13 Trimming and Finishing Earth Grade

- A. After the earth grade has been constructed to the required grade, all stones and rocks more than 3 inches (75 mm) in diameter, appearing on the surface of the subgrade shall be removed.
- B. Earth grade and the subgrade shall be trimmed to the grade called for on the Plans. Subgrade, where a subbase or base course is required, shall be trimmed to the established grade within ± 0.1 foot (30 mm). Where a subbase or base course is not required, the subgrade shall be trimmed to the established grade within $\pm 3/4$ inch (20 mm).
- C. Earth grade outside the subgrade shall be trimmed, all irregularities made smooth and the entire site or roadway completed to the required lines, grades, and cross sections. Backslopes and fill slopes shall be finished as either Class A or Class B slopes. Class A slopes shall be required unless otherwise specified in the Contract Documents.
 - 1. Class A Slopes:
 - a. Class A slopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.1 foot (30 mm) above or below the established grade measured at right angles to the slopes.
 - 2. Class B Slopes:
 - a. Class B backslopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.5 foot (150 mm) above or below the established grade measured at right angles to the slope. The degree of finish of the slopes shall be that obtainable from machine operations. The smoothness of surface finish ordinarily associated with template or string line and hand operations will not be required, but abrupt variations will not be permitted. Debris except sod, leaf mold and rotted forest litter shall be removed and loose clods of earth extending beyond the 0.5 foot (150 mm) tolerance shall be broken or removed.
 - b. Class B fill slopes shall be finished to within 0.2 foot (60 mm) of the established grade and cross section from the outside shoulder line for a distance of three (3) linear feet (0.9 m) down the slope. The remainder of the completed fill slope shall conform to the requirements for Class B backslopes.

- c. Where waste earth or other surplus material is deposited on fill slopes, the slopes may be flattened or otherwise altered as directed by ENGINEER, to produce a uniform cross section which blends with the topography and presents a pleasing appearance.
- D. Where trees or other restrictions do not interfere, the tops of backslopes, bottoms of fill slopes and all other angles in the lines of the cross section shall be rounded to form vertical curves as shown on the Plans or as determined by ENGINEER. Transitions in length of vertical curves shall be gradual and shall present a uniform and attractive appearance. When ditches are constructed in peat, vertical curves may be omitted.

3.14 Subbase

- A. Granular material for subbase shall be evenly spread and compacted as specified in MDOT Section 301.
- B. Thickness of each layer placed shall be determined by the required density obtained but shall not exceed 15 inches (375 mm) in depth, loose measure.
- C. Subbase shall be constructed to the alignment, grade and cross section shown on the Plans. Should the subgrade at any time prior to or during the placing of the subbase become soft or unstable so that rutting occurs in the subgrade, or if the subgrade material is forced up into the subbase material, the operation shall immediately cease and the mixed material shall be removed and disposed of. Subgrade shall be corrected and new subbase material placed and compacted. This Work shall be considered incidental to the construction of the Project.

3.15 Scarify, Re-Grade and Compact Existing Subgrade

- A. Existing subgrade (base) shall be scarified to a depth of 9-inches to the limits as shown on the plans. Subgrade shall then be re-shaped to the cross section as shown on the plans and compacted. Subgrade shall then be compacted to 95% of the maximum unit weight by rolling with a roller weighing not less than ten (10) tons (9000 kg).

3.16 Roadway Ditching

- A. Ditching shall be constructed at the locations called for on the Plans or as determined by ENGINEER. Ditch may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans.
- B. Excess material from the ditch construction shall be disposed of by CONTRACTOR at his expense.
- C. Ditch section shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding or Section 32 9223, Sodding.
- D. CONTRACTOR, at his expense, shall furnish, place and compact any additional material needed to construct the ditch at the location and cross sections called for on the Plans.

3.17 Right-of-Way Restoration

- A. Right-of-way shall be restored in accordance with the type and location specified on the Plans. Right-of-way may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans.

- B. Excess material from the right-of-way restoration operation shall be disposed of by the CONTRACTOR at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.
- C. Right-of-way shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding or Section 32 9223, Sodding.
- D. CONTRACTOR, at his expense, shall furnish, place, and compact any additional fill, meeting the approval of ENGINEER, needed to construct the right-of-way to the cross sections called for on the Plans.

3.18 Machine Grading

- A. Work of machine grading shall consist of light grading of such character that, in general, the excavation from ditches and roadbed will be utilized in shaping shoulders and adjacent shallow fills and the work can be performed by a blade grader or similar equipment. Machine grading shall apply on the sections shown on Plans or specified in the Proposal.
- B. Work shall include all necessary scarifying, plowing, discing, moving and shaping the earth to develop the cross section shown on Plans.
- C. Ditches shall be in reasonably close conformity with the line and grade as shown on the Plans or as directed and must drain runoff waters to outlets shown on the Plans or designated by ENGINEER.
- D. Roadbed shall be finished to grade with a blade grader or equivalent equipment.
- E. Intersections, approaches, entrances, and driveways shall be graded as shown or as directed, except that loading and hauling of earth will not be required as part of this Work.

3.19 Maintenance Aggregate

- A. CONTRACTOR shall furnish and install 21A, 21AA or 22A maintenance aggregate to maintain pedestrian and traffic access. Aggregate shall be placed and compacted to maintain access in areas as determined by ENGINEER. Maintenance aggregate will be incidental to the Project unless otherwise specified in the Contract Documents.

3.20 Testing

- A. During the course of the Work, ENGINEER may require testing for compaction, sieve analysis and moisture content of the backfill and subgrade materials.
- B. Taking of samples and the testing required shall be performed by a testing laboratory suitable to OWNER and approved by ENGINEER. Cost for testing and sampling shall be at the expense of OWNER.
- C. ENGINEER shall determine the location and number of samples to be made. The testing laboratory shall furnish the ENGINEER with two (2) certified copies of the results of all tests.
- D. Testing procedures shall conform to current MDOT Standards for Construction.

- E. Maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D, modified to include all the material passing the 1-inch (25 mm) sieve.

3.21 Defective Work

- A. Any portion of the backfill, subbase or subgrade which is deficient in the specified density shall be corrected by methods meeting the approval of ENGINEER.
- B. Extra testing or sampling required by ENGINEER, because of deficiencies, shall be at CONTRACTOR's expense.

End of Section

Section 31 2333 Trenching and Backfilling

Part 1 General

1.01 Scope of Work

- A. This Section includes open trench construction for utility installation, complete with trenching, sheeting, bracing, bedding, bedding materials, backfilling, backfill materials, and compaction.

1.02 Related Work Specified Elsewhere

- A. Section 01 8900: Site Construction Performance Requirements
- B. Section 33 3400: Sanitary Utility Force Mains

1.03 Reference Standards

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM - ASTM International
 - 2. AASHTO - American Association of State Highways and Transportation Officials
 - 3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Test Reports

- A. Testing laboratory shall provide ENGINEER with two (2) certified copies of the test results of the compaction of the backfill.
- B. Testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.05 Mix Design

- A. Submit mix designs for any concrete or flowable fill mixtures to be used on the Project. Include certified test results for seven day and 28 day strengths, together with any technical information for admixtures.

1.06 Soil Erosion and Sedimentation Control

- A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

- B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.
- C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

Part 2 Products

2.01 Class II Granular Materials

- A. Class II granular material gradation shall conform to the grading requirements for granular material Class II, as specified in MDOT, Section 902 except as follows. Class II granular material shall be natural bank run sand with a maximum size of 1½-inches (38 mm).

2.02 Crushed Stone Bedding

- A. Crushed, angular, natural stone material, meeting the requirements of MDOT 21AA. Crushed concrete and slag are not allowed.

2.03 Concrete

- A. Concrete shall conform to MDOT, Section 701, use grade S3; 3,000 psi (21 MPa) strength; Type I-A cement; 5.5 sacks cement per cubic yard (307 kg/m³); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's review.

2.04 Flowable Fill for Backfilling

- A. Materials:
 - 1. Fly Ash: Fly Ash shall have a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).
 - 2. Water: Water shall meet the requirements of ASTM C94.
 - 3. Cement: ASTM C150 or C595, Type I or IA.
- B. Mixture (Strength 100 - 120 psi, (690 - 825 kPa)):
 - 1. Fly Ash: 2000 lbs/c.y. (1190 kg/m³) min
 - 2. Cement: 70 lbs/c.y. (40 kg/m³) min
 - 3. Water: Sufficient water to produce desired flowability, 700 lbs/c.y. (415kg/m³) ±
- C. Temperature of the flowable fill mix as manufactured and delivered shall be at least 50 degrees Fahrenheit (10 degrees Celsius). Flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.

Part 3 Execution

3.01 Dewatering

- A. Area within the vicinity of the trenching operation shall be dewatered in accordance with Section 31 2319, Dewatering prior to the trenching operation.

- B. Depth of the dewatering shall be sufficient to allow the trench excavating operation including backfilling and compacting to proceed in a dry condition.

3.02 Trench Excavation

- A. Open cut trench excavation shall include the site clearing and grubbing, the excavating of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.
- B. Trenching operation shall commence at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified on the Plans or directed by ENGINEER.
- C. Trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by ENGINEER.
- D. Excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property, public property or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.
- E. Trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, for rigid pipe, the width of the trench from below the pipe bedding to 12 inches (300 mm) above the top of the pipe shall not exceed the following dimensions:

Diameter of Pipe	Width of Trench
6-inch thru 12-inch pipe (150 thru 300 mm)	30 inches wide (750 mm)
15-inch thru 36-inch pipe (375 thru 900 mm)	outside diameter plus 16 inches (400 mm)
42-inch thru 60-inch pipe (1050 thru 1500mm)	outside diameter plus 20 inches (500mm)
over 60-inch pipe (1500mm)	outside diameter plus 24 inches (600 mm)

- F. Support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, CONTRACTOR shall install, at his expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or four (4) inches (100mm), whichever is greater, or at his expense, install another type bedding, approved by ENGINEER. Concrete encasement shall consist of 3,000 psi (21 MPa) strength concrete.
- G. For flexible pipe, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 in. (400 mm) or the pipe outside diameter times 1.25, plus 12 in. (300 mm). Maximum trench width for flexible pipe shall not exceed the minimum width by more than 6-inches.
- H. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, CONTRACTOR shall install, at his expense, crushed stone pipe bedding to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe.
- I. When through, CONTRACTOR's construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, CONTRACTOR, at his expense, shall excavate below the normal trench bottom grade and shall fill the void with a large size aggregate or 3,000 psi (21 MPa) concrete as approved by

ENGINEER to ensure that the pipe when laid in the proper bedding will maintain correct alignment and proper grade.

- J. Trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.

3.03 Sheeting, Shoring, and Bracing

- A. CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipe lines, conduits next to or crossing the trench, and the protection and safety of pedestrian and vehicular traffic.
- B. CONTRACTOR shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil. Prior to installing the sheeting, shoring or bracing, CONTRACTOR shall submit Plans for this Work to ENGINEER for informational purposes only.
- C. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.
- D. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to CONTRACTOR for sheeting, shoring or bracing left in place.
- E. Supports for pipes, conduits, etc., crossing the trench shall conform to the requirements of the owners of such facilities, and if necessary, shall be left in place.
- F. The furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at CONTRACTOR's expense. CONTRACTOR shall not remove the trench sheeting, shoring and bracing unless the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads. Also the sheeting, shoring, and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

3.04 Pipe Bedding

- A. Install and compact in six inch layers. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of the pipe. Work in and around pipe by hand to provide uniform support.
- B. Rigid Pipe Bedding:
 - 1. Rigid pipe bedding shall conform to ASTM C12, except as noted.
 - a. Class R-A:
 - (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/4 of the outside diameter of the pipe, whichever is greater, and shall extend up the

sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least four (4) inches (100 mm) or 1/4 of the inside diameter of the pipe, whichever is greater, at the pipe crown and a minimum width equal to the outside diameter of the pipe plus eight (8) inches (200 mm) or 1-1/4 of the diameter of the pipe, whichever is greater.

b. Class R-B:

- (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches (300 mm) above the top of the pipe shall be Class II granular material. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

c. Class R-C:

- (1) Pipe shall be bedded in Class II granular material, placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches (300 mm) above the top of the pipe. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

C. Flexible Pipe Bedding:

1. Flexible pipe bedding shall conform to ASTM D2321, except as noted. Continuous and uniform bedding shall be provided in the trench for all buried pipe.

a. Class F-I:

- (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm), and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches (300 mm).
- (2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

b. Class F-II:

- (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm), or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches (300 mm) above the top of the pipe shall be Class II granular material. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.
- (2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

c. Class F-III:

- (1) Pipe shall be bedded in Class II granular material, placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches (300 mm) above the top of the pipe. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of the pipe.
- (2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

3.05 Backfilling Trenches

- A. Backfill material shall be placed on sections of bedded pipes only after such pipe bedding and backfill materials have been approved by ENGINEER.
- B. Trench backfilling shall follow the pipe laying as closely as possible. However, at no time shall the pipe laying in any trench precede backfilling of that trench by more than 100 feet (30 m), unless otherwise directed by ENGINEER.
- C. Backfilling shall not be done in freezing weather except by permission of ENGINEER. Frozen materials shall not be used in trench backfilling.
- D. Following trench backfill specifications are for use in that portion of the trench beyond the scope of the pipe bedding requirements which normally stops at a point 12 inches (300 mm) above the top of pipe.
 1. Backfill material to be placed above pipe bedding shall be free of cinders, ashes, refuse, boulders, roots, stumps, trees, timbers, brush, debris, or other extraneous materials which in the opinion of ENGINEER, are unsuitable.
 2. Rocks or stones having a dimension larger than six (6) inches (150 mm) shall not be placed within three (3) feet (1 m) of the top of the pipe .

3. Large stones may be placed in the remainder of the trench backfill only if well separated and arranged so that no interference with backfill settlement will result.
- E. The type and method of backfilling is dependent on its location and function and shall conform to the following requirements:
1. Trench "A":
 - a. All other trenches shall be backfilled with suitable excavated material placed in uniform layers that can be adequately compacted and tested from the surface of that layer. Each layer shall be thoroughly compacted by approved mechanical methods to a density equivalent to the undisturbed adjacent soil or 90% of its maximum unit weight which ever is less.
 2. Trench "B":
 - a. Trenches under road surfaces, pavement, curb, driveway, sidewalk and where the trench edge is within three (3) feet (1m) of the pavement and as noted on the plans shall be backfilled with natural bank run sand meeting the requirements of Class II granular material, unless otherwise indicated on the Plans. The material shall be placed in uniform layers that can be adequately compacted and tested from the surface of that layer and shall be compacted to 95% of the materials maximum unit weight. Trenches under pavement to be constructed in the near future, as noted or shown on the Plans, shall be backfilled with natural bank run sand, meeting the requirements of Class II granular material, unless otherwise indicated on the Plans, as herein provided.
 - b. Where a pipe is installed under an existing or proposed utility, the backfill between the two shall be natural bank run sand meeting the requirements of Class II granular material, unless otherwise indicated on the Plans, constructed as herein specified.
- F. Unless otherwise specified on the Plans or as directed by ENGINEER, the trench backfill shall be carried to the adjacent existing ground.
- G. Where any backfill or bedding as shown on the plans or specified is to be flowable fill, care shall be used to avoid displacing any pipes or structures due to fluid pressure. Pipes in backfill areas may need to be secured to avoid the bouyancy effect.

3.06 Compacting Trench "B" Backfill

- A. Trench "B" backfill shall be compacted to 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by ENGINEER.
- B. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil, to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 Cleanup

- A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements. The construction area shall be leveled and left in a neat workmanlike condition.
- B. At a seasonally correct time, approved by ENGINEER, the disturbed area shall be raked, having topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding.

3.08 Field Testing

- A. During the course of the Work, ENGINEER may require testing for compaction or density of the backfill. Taking of samples and the testing required shall be performed by a testing laboratory suitable to OWNER and approved by ENGINEER. The cost for testing and sampling shall be at the expense of OWNER.
- B. Maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method D.

3.09 Defective Work

- A. Any portion of the trench backfill which is deficient in the specified density shall be corrected by methods meeting the approval of ENGINEER.
- B. Any extra testing or sampling required because of deficiencies shall be at CONTRACTOR's expense.

End of Section

Division 32
Exterior Improvements

Section 32 9219 Seeding

Part 1 General

1.01 Scope of Work

- A. This Section includes seeding complete with earth bed preparation, providing and placing topsoil, preparation and fertilizing topsoil, sowing of seed for lawns and other ground cover, protection of seeded areas, watering of seeded areas, mowing of seeded areas, protection and cleanup.

1.02 Related Work Specified Elsewhere

- A. Section 01 2200: Unit Prices
- B. Section 01 8900: Site Construction Preparation Requirements
- C. Section 32 9223: Sodding

1.03 Requirements of Regulatory Agencies

- A. Comply with the applicable requirements of the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, Michigan Seed Law, Act 329, PA of 1965, as amended.
- B. Comply with the applicable requirements of the Proceedings of the Association of Official Seed Analysts, Rules for Testing Seeds.
- C. Chemical fertilizer shall be supplied in suitable bags with the net weight of the contents and guaranteed analysis shown on the container. Bulk shipments shall be accompanied by an analysis and net weight certification of the shipment. Custom mixed fertilizers shall be accompanied by a certification of the weight of each commercial fertilizer used in the mixture and a guaranteed analysis of each shipment expressed in percentages of total Nitrogen (N), total available Phosphoric Acid (P₂O₅) and total available Potash (K₂O) included.

1.04 Source Quality Control

- A. A seed mixture proposed for use in the Work shall have been tested for purity and germination by the Seed Producer within nine (9) months of sowing.

1.05 Reference Standards

- A. ASTM - American Society for Testing and Materials
- B. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.06 Submittals

- A. Submit Seed Producers Certification that seed meets the requirements of these Specifications and conform to the State of Michigan Seed Act referenced above under Article 1.03 of this Section.

- B. Where required, submit test reports for all seed proposed for use in the Work to ENGINEER, showing results of purity and germination tests, compliance with regulatory agencies, dates and location of tests.

1.07 Product Delivery, Storage, and Handling

- A. Material shall be delivered to the Project site in their original, unopened containers. Containers shall be clearly marked showing, name of manufacturer, brand name, trade name or generic name of material, warranty of analysis, net weight of contents and date of packaging, where applicable.
- B. Seed shall be delivered to the site in durable bags, tagged or labeled to show date of tests, warranty of purity and germination analysis, name, lot number and net weight of contents.
- C. Commercial fertilizers shall be delivered to the site of the Work in the original unopened bags. Bags shall not exceed 100 pounds (45 kg) net weight each and shall be clearly marked with guaranteed analysis in a conspicuous location on each bag.
- D. Material shall be stored at the Project site, under shelter, off the ground and shall be protected from damage by moisture, temperature, exposure to elements, vandalism or other action which might otherwise impair their use.
- E. Materials proposed for use in the Work shall be handled in a manner that will protect the material and the personnel involved in the Work. Handle seed in a manner which will protect the mixture from contamination or deterioration.

1.08 Environmental Requirements

- A. Seeding is limited to the periods between April 20 and June 1, August 10 to October 1 and after November 20 for as long as weather permits preparation of the seed bed without irrigation and/or mulch. With the use of irrigation and/or mulch, seeding can be done from April 20 thru October 1 inclusively.
- B. Comply with the limitations placed on the use of certain soil protection materials because of prevailing temperatures as described in this Section.
- C. Comply with the limitation placed on seeding applications because of wind velocity as described-in this Section.

1.09 Protection

- A. Provide suitably approved warning signs and barricades for protection of seeded areas from pedestrian or vehicular traffic. Protect all newly seeded areas during the progress of the Work and until completion of the turf establishment period.
- B. Protect all adjacent construction from topsoil spills and perform such cleanup of affected surfaces before it becomes compacted by traffic.

1.10 Final Acceptance

- A. CONTRACTOR shall establish a dense cover of seeded grass on disturbed areas.
- B. These areas shall be maintained until final acceptance of the Work by ENGINEER.

- C. ENGINEER will inspect the turf to insure that the grass seed is well established, weed free, in a growing and vigorous condition.
- D. Areas that do not meet the approval of ENGINEER shall be re-seeded at CONTRACTOR's expense.

Part 2 Products

2.01 Seed

- A. Seed and seeding mixtures shall be certified, mature, clean, dry, new crop seed products suitable for the specified applications and having the percentages of purity, germination and proportions, by weight, indicated in Table 1.

Table 1 - Seeding Mixtures						
Kind	Seeds		Mixture Proportions (%)			
	Purity	Germination	TDS	TUF	TGM	THM
Kentucky Blue Grass	98%	80%	5	10	10	30
Perennial Rye Grass	96%	85%	25	20	20	20
Hard Fescue	97%	85%	25	20	30	
Creeping Red Fescue	97%	85%	45	40	40	50
Fults Salt Grass	98%	85%*		10		

Table 2 – Soil Types and Location of Seeding			
Symbol for Turf Seed Mixture	Soil Type	General Location	Rate of Seeding lbs/ac (kg/ha)
TDS	Dry Sandy to Sand Loam	Rural or Urban	250 (280)
TUF	All Types	Freeway, Blvds, Streets	250 (280)
TGM	Medium to Heavy	All	250 (280)
THM	Loamy to Heavy	Home and Business Turf	250 (280)

- B. The specific mixture to be used shall be for the type of soil on the Project and the location of the seeding unless otherwise indicated on the Plans or as designated by ENGINEER.
- C. Hydroseeding shall consist of a blend of seed, fertilizer and hydromulch.

2.02 Mulching Material

- A. Straw:
 - 1. Small grain straw or grass or marsh hay acceptable to ENGINEER.
- B. Wood Excelsior:
 - 1. Green wood fibers, baled or blanket of type and manufacture acceptable to ENGINEER.
 - 2. Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.

3. Wood excelsior blankets shall be made of a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. The fabric net shall have a mesh size not exceeding 1-1/2" x 3" (40 mm x 75 mm) and shall be a woven of either cotton cord, twisted paper cord or a synthetic, biodegradable fiber. Blankets shall be produced in the form of a tightly compressed roll 36 inches ± 1-inch (900m m ± 25 mm) wide and approximately 120 feet (36 m) long. Blanket shall have a fiber net on the outside of the fiber mat. Blanket roll weight, when manufactured, shall average 85 pounds (38 kg) ± 10%. Each roll shall have separator sheets of 40 pound Kraft paper placed at the beginning and at the end of each roll to facilitate unrolling and handling at the job site. The Kraft paper sheet at the end of each roll shall also form a wrapper for the roll.

C. Netting:

1. Twisted Kraft paper or synthetic fiber, biodegradable woven mesh net material suitable for the application and acceptable to ENGINEER.
2. The net shall consist of a biodegradable mesh with openings not to exceed 1-1/2" x 3" (40 x 75 mm)
3. The net shall be furnished in widths of not less than 35 inches (900 mm).

D. Proprietary Mulch Material:

1. Biodegradable natural and/or synthetic materials suitably fabricated and acceptable to ENGINEER.

2.03 Mulch Anchoring Material

A. Emulsified Asphalt:

1. ASTM D977, Rapid Setting (R.S. 1 or 2), Medium Setting (M.S. 2 or 2h) or Slow Setting (S.S. 1).

B. Mulch Anchoring Tool:

1. Suitable unit having a series of flat, notched discs for punching and anchoring mulch in soil, or a regular farm disc weighted and set nearly straight as a substitute.

C. Latex Base Adhesive:

1. Latex base adhesive mixed with water at a ratio of 25 gallon of water to 1 gallon adhesive with 25 pounds of recycled newsprint as a tracer (14 L of adhesive with 0.35 kL of water with 28 kg of newsprint).

D. Recycled Newsprint:

1. Mix 7 pounds of newsprint with 7 gallons of water (60 kg of newsprint with 1000 L of water).

E. Guar Gum:

1. Mix 1 pound of dry adhesive with 26.5 gallons of water with 5 pounds of recycled newsprint as a tracer (55 kg adhesive / 12 200 L water / 280 kg newsprint).

2.04 Fertilizer

- A. Fertilizer shall be a standard commercial grade fertilizer, conforming to state regulations, of the type recommended for grasses. The fertilizer shall contain slow release nitrogen amounting to 75% of the nitrogen available. Fertilizer shall be uniform in composition, free flowing and suitable for application with method selected. Fertilizer for hydraulic seeding shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the slurry.

2.05 Agricultural Liming Materials

- A. Burnt lime (quick lime), hydrated lime, limestone (calcite and dolomite), marble shells and by-products shall conform to the requirements of ASTM C602.

2.06 Water

- A. Free of matter harmful to plant growth.

2.07 Staples

- A. Wire staples for holding mulching materials in place shall be not less than six (6) inches (150 mm) long No. 11 (U.S. Steel Gage) steel wire or longer.

2.08 Topsoil

- A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than one (1) inch (25 mm) in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

1.	Soil pH.....	5.0 to 7.5
2.	Soluble Salts.....	500 ppm max
3.	Organic Content.....	5 to 30 %
4.	Silt Content.....	35% to 50%
5.	Clay Content.....	5% to 10%
6.	Deleterious Material*.....	5% max

*rock, gravel, stone, sticks, roots, sod, etc.

- B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8-inch (15 mm) maximum mesh screen prior to delivery to the Project site. ENGINEER shall review source and final screen results prior to release of topsoil. CONTRACTOR shall submit a certified analysis of the topsoil from each source to ENGINEER. Topsoil shall be placed in 3-inch (75 mm) minimum thickness throughout, or as specified in the plans or Specifications.
- C. CONTRACTOR shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at his own expense.

2.09 Improved Topsoil

- A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable as defined in P.A. 641 as amended and shall be in compliance with all federal and state law.

- B. The improved topsoil mixture shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor. The mixture shall be free of glass, plastic, metal, and other contaminants, as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.
- C. The manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.
- D. The composition of the compost shall be within the following range of values:
- | | | |
|-----|-----------------------------|------------------------------|
| 1. | Quality Parameter..... | Range of Value |
| 2. | Soil pH..... | 6 to 7.5 |
| 3. | Soluble Salts..... | 2 to 5 mmho/cm |
| 4. | Carbon/Nitrogen Ratio..... | 13 to 20 parts C to 1 part N |
| 5. | Inerts..... | < 1% |
| 6. | Organic Matter..... | 35 to 55 % |
| 7. | Nitrogen..... | 1 to 2 % |
| 8. | Phosphorus..... | 0.2 to 0.8 % |
| 9. | Potassium..... | 0.5 to 1.5 % |
| 10. | Unit Weight..... | 535 to 775 Kg/m ³ |
| 11. | Moisture Content..... | 40 to 50 % |
| 12. | Particle Size..... | < 20 mm maximum |
| 13. | Water Holding Capacity..... | > 100% |
| 14. | Heavy Metals..... | None |
- E. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.
- F. Temperature: The compost material must have undergone the procedure to significantly reduce the pathogen level as referenced in EPA 40 CFR, Part 257 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations. The temperature must be maintained at 40° C for 5 days with a temperature exceeding 55° C for at least 4 hours.
- G. Pathogens and Trace Elements: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.
- H. To comply with the annual filing requirements with the Michigan Department of Agriculture, Pesticide and Plant Management Division, the supplier of the compost shall certify that the compost meets Michigan P.A. 641 as amended and EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.
- I. A data sheet shall accompany the certification.
- J. The data sheet shall show the following:
1. Standard compost total nutrient test results, including N, P, K, Ca, Mg, Mn, Cu, Fe total carbon, pH, as provided by an acceptable testing laboratory
 2. Organic content
 3. Inert contamination
 4. Soluble salts

5. Carbon/Nitrogen ratio
 6. Proof of maturity/stability acceptable to the Michigan Department of Agriculture
- K. The certification and data sheets shall be mailed annually to the Michigan Department of Agriculture, Agriculture Environment Coordinator. The date shall be included on which the compost test results were mailed to the Michigan Department of Agriculture.

Part 3 Execution

3.01 Preparation of Subgrade

- A. Complete all fine grading within the areas to be covered with topsoil necessary to bring the surface of the proposed subgrade to the elevations indicated on the Plans and parallel to the proposed finished grade. The surface of the subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a minimum depth of two (2) inches (50 mm) to facilitate making a bond between the subsoil and the topsoil.

3.02 Preparation of Soil

- A. After the areas to be seeded have been brought to the required grade and properly trimmed and cleaned up, the existing soil shall be brought to a friable condition by harrowing or otherwise loosening and mixing to a depth of at least four (4) inches (100 mm). Lumps and clods shall be thoroughly broken. When the area to be seeded has been prepared and covered with a layer of topsoil as specified under Article 3.01 of this section, this operation will not be required.

3.03 Preparation of Mulch Material

- A. When seed is to be sown through mulch which has been in place for a period of more than two (2) weeks or which is being held in place by a surface-applied coating of asphalt emulsion or other adhesive, the mulched area shall be prepared for seeding by discing, a spike-toothed harrow, or by other means acceptable to ENGINEER.

3.04 Placing and Spreading Topsoil

- A. Topsoil shall be placed and spread over the area designated on the Plans, or as determined by ENGINEER, to a depth of four (4) inches, \pm 1-inch (100 mm \pm 25 mm) or to such depth as specified on the plans.
- B. In all cases, topsoil shall be placed to a depth sufficiently greater than that shown on the Plans or specified so that, after natural settlement or rolling, the completed Work will conform to the lines, grades and elevations shown on the Plans.
- C. Spreading of topsoil shall be completed in such a manner that seeding as specified can proceed without additional moving of topsoil. Topsoil furnished and placed shall be considered incidental to seeding unless otherwise specified in the Proposal.
- D. After topsoil is spread, all large earth lumps, rocks, roots, debris, or other foreign matter shall be raked and removed from the topsoiled area and legally disposed of by CONTRACTOR.

3.05 Fertilizing

- A. Chemical fertilizer shall be applied on the prepared soil surfaces at a minimum rate of 1/3 ton per acre (666 lbs/ac.) (750 kg/ha) of 12-12-12 fertilizer, or such other rate of another fertilizer mixture that yield 240 lbs/acre (270 kg/ha) of nutrient. Dry fertilizers shall be thoroughly disced, harrowed or raked into the soil to a minimum depth of not less than 1-inch (25 mm). Where hydraulic seeders are used for sowing seed, one half the recommended rate of fertilizer may be spread in combination with such sowing with the balance incorporated into the soil prior to seeding. In all other cases, fertilizer shall be incorporated into the soil before any seeding is started.

3.06 Seeding

- A. Seed of the kind required shall be sown at the rate as specified in Table 2. Seed shall be sown in the presence of an inspector by mechanical spreader, hydraulic seeder or broadcasting. The broadcasting method shall be used for sowing seed only in areas inaccessible to mechanical spreading equipment. Seeding during winds above 15 miles per hour (25 km/hr) shall not be permitted.
- B. Prior to placing seed materials, water topsoil to a depth of four (4) inches (100 mm) at least 48 hours prior to seeding operations to obtain a loose friable seed bed. Time and depth of watering operations shall be varied at the direction of ENGINEER for varying conditions at the site of the Work.
- C. Broadcasting methods for sowing seed materials shall be accomplished by spreading one-half of the specified amount of seed in one direction and then broadcasting the remaining one-half of the seed at right angles to the first seeding pattern using the same broadcast method. Rate of broadcast shall be as specified herein or per the written recommendations of the Producer of the seed material used. Roll seeded area with roller weighing a maximum of 150 pounds/foot (225 kg/m) of width.
- D. Hydroseeding shall be performed using suitably acceptable hydraulic seeding equipment and a homogeneous slurry solution of water, seed, fertilizer and suitable mulch material as approved by ENGINEER. Seed slurry mixture shall be distributed uniformly at a rate approved by ENGINEER for the seed materials, fertilizer and/or mulch materials used to suit the seed application rate. Seed application rate shall be 300 lbs/acre (340 kg/ha).

3.07 Mulching

- A. Mulching shall consist of placing a mulch material on areas that have been or are to be seeded. Mulch shall be placed in a loose enough condition so as to allow penetration of sunlight and circulation of air, but thick enough to shade the ground, reduce rate of water evaporation and prevent or reduce erosion by wind or water. Mulch shall be secured with suitably acceptable anchoring material.
- B. For surfaces and slopes on which power equipment can be operated, satisfactory mulching materials include the following:
- C. Small grain wheat straw or grass hay applied at 1-1/2 to two (2) tons per acre (3.5 to 4.5 metric ton/ha) with disc packer, asphalt or netting tie-down.
- D. Wood chips applied at six (6) to nine (9) tons per acre (13.5 to 20.0 metric tons/ha).

- E. Asphalt emulsion alone at 600 to 1,200 gallons per acre (5.5 to 11. kl/ha). (This application is suitable for limited periods of time and where trampling by either people or animals will not occur.)
- F. For surfaces and slopes where power equipment cannot be operated, satisfactory mulching materials include the following:
- G. Straw or grass hay applied at 1-1/2 to two (2) tons per acre (3.5 to 4.5 metric tons/ha), anchored with asphalt or netting tie-down.
- H. Asphalt emulsion alone at 600 to 1,200 gallons per acre (5.5 to 11.0 kl/ha). (Limited to areas where tracking is not a problem.)
- I. Commercially available erosion control netting of jute, paper or biodegradable synthetics.
- J. Continuous filament fiberglass at 1,000 pounds per acre (1100 kg/ha) anchored with 150 gallons (1400 l/ha) of asphalt emulsion.
- K. Anchor straw or hay mulch by the methods as specified herein.
- L. Wood chips will not need anchoring when used on workable slopes.
- M. Commercially manufactured netting and/or fiberglass materials shall be anchored in accordance with the manufacturer's printed instructions for the material used.
- N. Punch and anchor mulch material into soil using mulch anchoring tool. Soil must be moist, free of stones and loose enough to permit disc penetration to a depth of three (3) inches (75 mm).
- O. Blow on liquid or emulsified asphalt materials with the straw or hay mulch or spray or sprinkle asphalt tie-down materials immediately after mulch is spread.
- P. Apply emulsified asphalt at 0.04 gallons per square yard (0.2 l/m²). Do not apply emulsified asphalt during freezing weather since it contains approximately 50% water. Apply liquid (cut back) asphalt at approximately 0.10 gallons per square yard (0.45 l/m²). Liquid asphalt may be applied during freezing weather since it is cut back with kerosene.

3.08 Conversion from Soil Protection to Permanent Vegetation

- A. Following straw or hay mulching, grass seeding can be made in early spring by broadcasting seed directly into the mulch. Fertilizer or lime, where needed, should be incorporated into the soil before mulching.
- B. Asphalt emulsion alone can be readily incorporated into the soil by ordinary tillage before seeding.
- C. Wood chip mulch may be removed before seeding or incorporated deeply into the soil. If wood chips are incorporated into the soil, the addition of extra nitrogen fertilizer to the soil will be required to provide nitrogen in the new seeding.
- D. Fiberglass mulch shall be removed before seeding because of its permanence. Care shall be taken to prevent fiberglass filaments left in place from becoming entwined or wound around shafts of power mowers or other power equipment.

- E. Acceptable proprietary netting and erosion control materials shall be disposed of in accordance with the manufacturer's printed instructions for the material used prior to any seeding operations.

3.09 Turf Establishment

- A. Seeded areas shall be watered whenever excessive drying is evident during the period set for establishment. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities and the watering equipment shall be of a type that will prevent damage to the cultivated surfaces. CONTRACTOR shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.
- B. The seeded areas shall be mowed with mowing equipment acceptable to ENGINEER to a height of two (2) inches (50 mm) whenever the average height of grass establishment reaches four (4) inches (100 mm). When the amount of cut grass is heavy, cut grass shall be removed to prevent destruction of the underlying grass. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed, or in the case of rank growths, shall be uprooted, raked and legally disposed of from the area.
- C. Reseed and mulch areas larger than four (4) square inches (25 cm²) not having a dense, uniform, vigorous stand of grass acceptable to ENGINEER.
- D. The establishment period shall extend for a period from the time of seeding until the seeded area has a uniform stand of grass acceptable to ENGINEER. The minimum period shall be 30 days.
- E. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by CONTRACTOR, OWNER may reseed the defective areas and all costs will be deducted from CONTRACTOR's payments.

End of Section

Division 33
Utilities

Section 33 0513 Manholes and Structures

Part 1 General

1.01 Scope of Work

- A. This Section includes Monolithic concrete manholes with lid frame, covers, anchorage and accessories, as well as modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage and accessories.

1.02 Related Work Specified Elsewhere

- A. Section 01 2200: Unit Prices
- B. Section 04 0511: Mortaring and Grouting
- C. Section 31 2333: Trenching and Backfilling

1.03 Requirements of Regulatory Agencies

- A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 Reference Standards

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ACI - American Concrete Institute
 - 2. ASTM - ASTM International

1.05 Submittals

- A. Shop Drawings: Indicate manhole and vault locations, elevations, piping, conduit, and sizes and elevations of penetrations.
- B. Product Data: Provide manufacturer's data and installation instructions for precast manhole and vault sections, joint connections, water stops, gaskets, corrosion protection system, flexible pipe joints, chimney seals, manhole and vault castings, and other pertinent information for precast and cast-in-place manholes and vaults.
- C. Manufacturers Certification: Certify that all products furnished meet or exceed the specified requirements, including worst case depth loadings for this project.
- D. Calculations: Submit calculations for review sealed and signed by a registered Professional Structural Engineer in the State of Michigan. Include structural, depth of bury, buoyancy, and all other information necessary to determine adequacy of the item.
- E. Results of manhole and vault leakage and vacuum tests

1.06 Design Requirements

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.
- B. Design of Lifting Devices for Precast Structures: In accordance with ASTM C 890 "Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures." Provide lifting inserts designed for four times the anticipated lifting load. Grout inserts in place when complete.
- C. Design of Joints for Precast Structures: Gaskets in accordance with ASTM C 923 "Standard Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals" with maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.
- D. Use precast concrete manholes or vaults designed by the precast manufacturer's registered Professional Structural Engineer, licensed in the State of Michigan in accordance with the Contract Documents. Furnish precast concrete manholes, however, conforming to the following minimum design requirements in addition to the ASTM standards referenced in this Section:
 - E. The top slab of all manholes or vaults shall be designed for an H-20 truck loading.
 - F. Minimum manhole or vault base slab thickness shall be eight (8) inches up to twenty five (25) feet depth and twelve (12) inches over twenty five (25) feet depth.
 - G. Manholes and vaults shall resist buoyancy due to flooding with a high ground water table elevation at the top of the precast concrete structure. The factor of safety against buoyancy shall be 1.20. Buoyancy calculations shall be provided with the submittal.
 - H. Walls backfilled with cohesive soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 135 pounds per square foot (psf) per foot of wall height for walls below the ground water table.
 - I. Walls backfilled with granular soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 125 psf per foot of wall height for walls below the ground water table.
 - J. Design walls for surcharge load from adjacent structures or minimum 300 psf surcharge, whichever is greater.
 - K. Loads associated with testing manholes and vaults for water-tightness by vacuum testing in accordance with this Section.

1.07 Delivery, Storage and Handling

- A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes, vaults and drainage structures.
- B. Store precast concrete manholes, vaults and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

1.08 Qualifications

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

Part 2 Products

2.01 Valve Vaults, Manholes, Frames, and Covers

- A. Valve Vaults and Manhole Manufacturers:
 - 1. Northern Concrete Pipe, Inc.
 - 2. Mack Industries
 - 3. ENGINEER-approved equal.
- B. Manhole and Vault Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
- C. Benching:
 - 1. Provide full height and poured-in-place benching.
 - 2. Use non-shrink grout as specified in Section 04 0511.
 - 3. Appropriate granular filler may be used, subject to the approval of Engineer.
- D. Watertight Cover and Frame Manufacturers:
 - 1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
 - 2. Neenah Foundry Co. - Model R-1916-F.
 - 3. ENGINEER-approved equal.
- E. Cover and Frame Product Description:
 - 1. ASTM A48, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.02 Storm Sewer Manholes, Frames, and Covers

- A. Storm Sewer Manhole Manufacturers:

1. Northern Concrete Pipe, Inc.
 2. Mack Industries
 3. ENGINEER-approved equal.
- B. Cover and Frame Manufacturers:
1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
 2. Neenah Foundry Co. - Model R-1916-F.
 3. ENGINEER-approved equal.
- C. Cover and Frame Product Description:
1. ASTM A48, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.03 Other Manhole and Vault Components

- A. Steps: Per Contract Drawings.
- B. Base Slab:
1. Per Contract Drawings, cast-in-place concrete of type specified in Section 03301 or integral, monolithically cast precast concrete or standard tee pipe base sections.
- C. Pipe to Manhole/vault Connection:
1. Unless noted otherwise on the Contract Drawings, use a resilient type connector, in accordance with ASTM C-923, to connect pipes to the manhole. Use an A-Lock press wedge, Kor-n-Seal, or Res-Seal connector. No substitutions will be allowed. Non-shrink grout may only be used per the Contract Drawings or with written permission of the Engineer.
- D. Manhole and Vault Chimney Seals:
1. As shown on the Contract Drawings, seal the outside of the manhole or vault cone or riser section to the grade rings and manhole and vault frame with a heat shrinkable wrap or a compressible rubber seal with 304 stainless steel compression bands.
 2. Manufacturers:
 - a. Canusa - WrapidSeal Manhole Encapsulation System.
 - b. Cretex Specialty Products - External Manhole Seal.
 - c. ENGINEER-approved equal.

2.04 Configuration

- A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female gasketed joints; flexible rubber joint to receive pipe.
- B. Shape: Cylindrical.
- C. Clear Inside Dimensions: As indicated on Contract Drawings and as required for construction.

- D. Design Depth: As indicated on Contract Drawings and as required for construction.
- E. Clear Lid Opening: As indicated on Contract Drawings and as required for construction.
- F. Pipe Entry: Provide openings as indicated on Contract Drawings and as required for construction.
- G. Steps: As indicated on Contract Drawings and required by applicable safety code.

2.05 Bedding and Cover Materials

- A. Structure and Pipe Bedding: Fill Type A1, A2 or A5 as specified in Section 31 2333 and on the Contract Drawings.
- B. Topsoil Fill Type: S3 or S4 as specified in Section 31 2333 and on the Contract Drawings.
- C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1 or S2, as specified in Section 31 2333 and on the Contract Drawings.

Part 3 Execution

3.01 Examination

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes or vault is correct.

3.02 Preparation

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.
- B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.
- D. Prepare manhole or vault for installation of chimney seals per manufacturer's instructions.

3.03 Installation

- A. Excavation and Backfill:
 - 1. Excavate for manholes, vaults and drainage structures in accordance with Section 31 2316 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
 - 2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes, vaults or drainage structures in dry trench.
 - 3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.
 - 4. Placement and compaction of surrounding backfill material shall be accomplished to provide sufficient and equal side pressure on the manhole or vault.

- B. Backfill excavations for manholes, vaults and drainage structures in accordance with Section 31 2316.
- C. Form and place manhole cylinder or vault wall plumb and level, to correct dimensions and elevations.
- D. Connect pipe with flexible rubber joints as shown on the Contract Drawings.
- E. Set cover frames and covers level without tipping, to correct elevations.
- F. Install chimney seals per manufacturer's instructions and Contract Drawings.
- G. Coordinate with other sections of Work to provide correct size, shape, elevation, and location.
- H. Use manufacturer's recommended method, procedure and equipment for handling, installing, and connecting the manholes or vaults.

3.04 Standard Precast Concrete Manhole, Vault and Drainage Structure Installation

- A. Prepare granular bedding as shown on Drawings, to receive integral, monolithically cast base slab as specified.
- B. Lift precast structures at lifting points designated by manufacturer. Grout all lifting holes when structure is in place.
- C. When lowering manholes, vaults and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- D. Set precast structures bearing firmly and fully on granular bedding, compacted in accordance with provisions of Section 02320 or on other support system shown on Contract Drawings.
- E. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.
- F. Remove foreign materials from joint surfaces and verify gaskets are installed properly.
- G. Maintain alignment between sections by using guide devices affixed to lower section.
- H. Verify manholes, vaults and drainage structures installed satisfy required alignment and grade.
- I. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Connect pipe to manhole or vault with a flexible rubber joint as specified. Fill annular space with mortar.
- J. Cut pipe to finish flush with interior of structure.
- K. Shape inverts through manhole or vault as shown on Contract Drawings. Provide cast-in-place full height benching. Trowel smooth and slope to drain per Contract Drawings.

3.05 Castings Installation

- A. Set frames using a precast concrete grade ring with butyl rope to seal joint. Use grade ring sizes per Contract Drawings
- B. Unless Contract Drawings indicate otherwise, set frame and cover 6 inch above finished grade for manholes, vaults and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
- C. Set frame and cover flush with ground surface for manholes, vaults and other structures located within paved areas.

3.06 Leakage Testing For Manholes and Vaults

- A. After completion of manhole or vault construction, inspect all manholes for leakage and repair all visible leaks.
- B. After repairing all leaks, test manholes and vaults for water-tightness using vacuum testing procedure as follows:
 - 1. Temporarily plug the influent and effluent lines with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for the pressure required for the test. Place plugs a minimum of 6 inches outside the manhole or vault walls. Brace inverts to prevent lines from being dislodged.
 - 2. Install vacuum tester head assembly at the top access point of the manhole or vault and adjust for a proper seal. Following manufacturer’s instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure. Do not over-inflate.
 - 3. Evacuate manhole or vault with vacuum pump to 10-inches of mercury (Hg). Disconnect the pump and monitor vacuum for the time period specified in the following table:

Vacuum Test Timetable

Depth (feet)	Test Duration (seconds)			
	48-inch Diameter Manhole**	60-inch Diameter Manhole**	72-inch Diameter Manhole**	96-inch Diameter Manhole**
4	30	30	30	30
8	30	30	32	38
12	30	39	48	57
16	40	52	64	76
20	50	65	80	95
24	60	78	96	114
Each 2' more	+5	+6.5	+8	+9.5

** Use equivalent volume for testing vaults

- 4. If the drop in vacuum exceeds 1-inch of mercury (Hg) over the specified time period, locate the leaks and complete repairs necessary to seal the manhole or vault. Repeat the test until acceptable results are obtained.

3.07 Field Quality Control

- A. Test concrete in accordance with Section 03 3000.
- B. Vertical Adjustment of Existing Manhole and Drainage Structures:
 - 1. Where required, adjust top elevation of existing manholes and drainage structures to finished grades shown on Drawings.
 - 2. Reset existing frames, grates, and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
 - 3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.
 - 4. Clean and apply sand-cement-bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 3000.

End of Section

Section 33 3400

Sanitary Utility Force Mains

Part 1 General

1.01 Scope of Work

- A. This Section includes underground force main work complete with piping, valves, force main manholes, fittings, thrust blocks, retainers, plugs and accessories required for installation as indicated on the Plans and specified herein. This Section also includes hydrostatic testing of completed portions of new force main.

1.02 Related Work Specified Elsewhere

- A. Section 01 2200: Unit Prices
- B. Section 31 2333: Trenching and Backfilling
- C. Section 04 0511: Mortaring and Grouting

1.03 Reference Standards

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ANSI - American National Standards Institute
 - 2. ASTM - ASTM International
 - 3. AWWA - American Water Works Association
 - 4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest addition

1.04 Submittals

- A. Product Data:
 - 1. Submit catalog data showing pipe sizes, and manufacturing standards, as well as design calculations for internal pressure, vacuum and external load conditions, for both non-restrained and restrained joints.
- B. Quality Assurance Materials:
 - 1. Quality assurance test procedures, test reports for pipes, specials and fittings shall be submitted to ENGINEER.

1.02 Closeout Submittals

- A. The following shall be submitted in accordance with Section 01 7700, Closeout Procedures:
 - 1. Manufacturer's field reports.
 - 2. Project record documents:
 - a. Accurately record actual locations of piping mains, valves, connections, and invert elevations.

1.05 Delivery of Materials

- A. For pre-stressed concrete pipe provide 2 percent of pipe lengths to be delivered as short pieces with 10 feet (3 m) or less. These short pieces shall be in addition to those required under the tabulated laying schedule.

1.06 Storage of Materials

- A. Pipe shall be stored in a manner to minimize infiltration of dirt, debris, and other extraneous materials.
- B. Piping materials shall not be stacked higher than 4 feet (1.2 m). Suitable racks, chairs, and other supports shall be provided to protect performed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers, and chock tier ends.
- C. Joint and sealing materials subject to ultraviolet or ozone attack and used in the force main system shall be protected from the sunlight, atmosphere and weather, and stored in suitable enclosures until ready for installation.

1.07 Handling of Materials

- A. Load and unload piping using suitable hoists and skidding. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping shall not be used by CONTRACTOR.
- B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

1.08 Environmental Requirements

- A. Cast iron or ductile iron pipe joints shall comply with the requirements due to outside ambient air temperatures specified under Article 3.05 of this Section.

Part 2 Products

2.01 General

- A. It is the intent of the Articles in Part 2 of this specification section is to specify in detail the various types of pipe, joints, and fittings which have been indicated throughout the Plans and Specifications. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 Ductile Iron Pipe

- A. Ductile iron pipe shall be ANSI/AWWA C151/A21.51, with double thickness cement mortar lining inside and 1-mil (25 µm) minimum thickness asphaltic coating outside. Pipe shall have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans.
- B. Mechanical joints for ductile iron pipe shall be compression gasket type, conforming to ANSI/AWWA C111/A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.
- C. Push-on joints for ductile iron pipe shall be compression gasket type conforming to ANSI A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.
- D. Fittings and plugs shall be ductile iron, mechanical joint, pressure rating of 350 psi (2.4 MPa), conforming to ANSI/AWWA C153/A21.53, and ANSI/AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.
- E. Nuts and bolts shall be high strength low-alloy steel conforming to ANSI/AWWA C111/A21.11.
- F. Flexible ball and retainer type joints shall be ball and retainer type, boltless, locking, and capable of being deflected up to 15 degrees.
- G. Flange joints shall have full face neoprene gaskets, 1/8-inch-thick and conform to ANSI B16.1. Carbon steel bolts shall conform to ASTM A449 with nuts conforming to ASTM A563 Grade B. Stainless steel bolts and nuts shall conform to ASTM A320. Bolt head and nuts shall be hex. Piping connection bolts and nuts used on this Project including piping in the wet areas shall be cadmium plated. Flange joints shall not be buried.
- H. Cement mortar lining for cast iron and ductile iron piping shall conform to the requirements of ANSI/AWWA C104/A21.4 of the thicknesses specified and shall be permanently set prior to the application of additional pipe coating.

2.03 Prestressed Concrete Pipe Systems

- A. Concrete pipe shall be prestressed concrete, embedded cylinder type, 175 psi plus load design pressure conforming to AWWA C301. Seal coat in accordance with ANSI/AWWA C104/A21.4 as applicable.
- B. Joints for concrete pipe shall be push-on, steel ring, gasket type conforming to AWWA C300 or AWWA C301.
- C. Fittings shall be AWWA C300, Type A, concrete or mortar lined with reinforced concrete or mortar exterior covering. AWWA C300, Type B, cut and welded steel plate mortar coated on interior and exterior.
- D. Seal coat concrete pipe with bitumastic concrete penetrant conforming to ANSI/AWWA C104/A21.4. Apply after pipe has cured.

2.04 Polyvinyl Chloride (PVC) Piping Systems

- A. Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings conforming to ASTM D2241, SDR 21, pressure class 200, unless indicated otherwise in the Contract Documents. Spigot end of pipe shall be marked to visually determine when the spigot is fully seated in the bell of the adjoining pipe.
- B. Joints for PVC pipe shall be Push-on, elastomeric gasket type, conforming to ASTM D3139.
- C. PVC fittings shall only be allowed when called for on the plans. When allowed, PVC fittings shall be SDR-21, conforming to ASTM D2241, D3139 and F477.
- D. Fittings for PVC pipe, unless specified otherwise, shall be Class 250 psi, manufactured of ductile iron, grade 80-55-06 in accordance with ASTM A536. Fittings shall have mechanical joints with gaskets meeting ASTM F477. Fittings shall have radii of curvatures conforming to ANSI/AWWA C153/A21.53 and shall be cement lined in accordance with AWWA C104.
- E. Gaskets for PVC pipe shall be elastomeric seal type conforming to ASTM F477.
- F. Pipe joint lubricant shall be manufacturers standard nontoxic.

2.05 Subaqueous Pipe

- A. Pipe shall be ductile iron, ANSI/AWWA C151/A21.51, with double thickness cement mortar lining and 1-mil (25 μm) thickness minimum of coal tar enamel inside and outside. Pipe shall have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans.
- B. Bell assembly shall conform to ANSI/AWWA C153/A21.53, threaded onto pipe in accordance with ANSI B2.1. Spigot shall have raised bead cast with the pipe and machined to form shoulder.
- C. Joint shall be made by a retaining ring and gasket assembly compressed between an outer ring and the shouldered spigot. Steel retaining rings shall seat the gasket inside the spherical bell and provide a positive stop for the spigot. Gasket shall be a high quality molded rubber and duck tipped. Tee head bolts and hexagonal nuts shall be stainless steel.

2.06 Restrained Joints

- A. Where the plans or specifications call for restrained joints they shall be per the following.
- B. Restrained joints for ductile iron pipe and fittings shall be designed for a working pressure of 350 psi (2.4 MPa). Joints shall be capable of being deflected after assembly. Restraints shall be by a positive axial lock between the bell interior surface and a retainer weldment on the spigot end of the pipe.
- C. Restrained joints for PVC force main pipe shall be designed for a working pressure of 200 psi (1.4 MPa). Where the restrained portion of the pipe is connected to fittings, restraint shall be provided across the joint by a clamping ring and anchored to the fitting with T-head bolts or stainless-steel rods. Restraining devices for PVC water main pipe shall incorporate clamping rings with serrations on the inside surface to provide positive restraint on the outside surface of the pipe and shall provide full support around the circumference of the pipe to maintain roundness.

2.07 Polyethylene Encasement

- A. Polyethylene material for encasement shall be either 4 mil high density, cross-laminated polyethylene film or 8 mil linear low-density polyethylene film per ANSI/AWWA C105/A21.5.

2.08 Gate Valves

- A. Provide iron body, resilient seated, solid wedge type gate valves with non-rising stems and O-ring seals in accordance with AWWA C509.
- B. Furnish buried valves with mechanical joint ends, stainless steel hardware, and 2" square operating nut. Where the force main is buried at a depth where the normal valve operating nut will be at a depth greater than 5-1/2 feet, a valve extension stem with operating nut shall be provided and mechanically attached to the valve to provide an operating nut at the 5-1/2-foot depth.
- C. Valves shall open counterclockwise.
- D. Gate valves shall be as manufactured by East Jordan, or equal.

2.09 Eccentric Plug Valves

- A. Valve body shall be full ported, cast iron and comply with AWWA C504. Inlet and outlet connections shall be compatible with the pipe joints used.
- B. Body seats shall be synthetic rubber reinforced by a nickel alloy conforming to ASTM B127. Seats shall be adequately reinforced and secured to the body to prevent the seat from becoming inflated by the pressure from behind.
- C. Bearings shall be replaceable sleeve-type with one set being thrust resistant to hold the plug securely in the center of the seat. Self-lubricated bearings shall have proven record of durable service.
- D. Shaft seals shall conform to AWWA C504 and C507.

2.10 Air Release Valve

- A. Air Release valves shall have an ASTM A126 Class B cast iron body and cover with a threaded inlet connection of the size shown on the plans or listed in the schedule and a 1/2-inch NPT outlet connection. Valve body shall have a 2-inch NPT plugged port near the base to facilitate cleanout of large solids as well as a 1/2-inch NPT connection near the top and 1-inch NPT port near the bottom to permit the installation of flushing attachments.
- B. Valves shall have an 18-8 stainless steel float and a replaceable seat of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel, plastic or bronze is not acceptable. Linkage mechanism shall be capable of being removed from the cover without disassembly of the mechanism. Valves shall have 3/16-inch diameter stainless steel orifice for working pressures up to 150 PSI.
- C. Provide flushing attachments to include 1/2-inch flushing valve, 1-inch blowoff valve, 5 feet of rubber hose and quick disconnect couplings.
- D. Valve shall automatically exhaust accumulated air from a fluid system while the system is pressurized and operational.

2.11 Combination Sewage Air Release and Vacuum Valves

- A. Wastewater combination air valves shall be constructed of cast iron body and cover, stainless steel plug, guide shaft, bushings and float, Buna-N seat.
- B. Valves shall be automatic float operated valve designed to releases air, gas or vapor during filling of a force main and close upon liquid entry, and allow air to re-enter when draining or under a negative pressure.
- C. Valve shall also release accumulated air from a force main while the system is in operation and under pressure. Valves shall have working pressure of 150 psi (1000kPa).
- D. CONTRACTOR shall provide a backwash system to be included with the valves consisting of an inlet shut-off valve, blow-off valve, clear water inlet valve and rubber supply hose with quick disconnect couplings.

2.12 Concrete Brick

- A. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3-inch (75 mm) thickness.

2.13 Concrete Block

- A. ASTM C139, Type II, shape and scored as detailed and as approved.

2.14 Precast Concrete Units

- A. Precast concrete units, flat top slabs, riser, cone, transition sections and bottom sections shall conform to ASTM C478, and shall be circular with circular reinforcement. For depths greater than 32-feet, the manhole shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5. Base slab shall be eight (8) inches (200 mm) thick for depths up to 25 feet (7.5 m) and 12 inches (300 mm) thick for depths greater than 25 feet (7.5 m).
- B. Transition sections, reducers and flat top slabs shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
- C. Precast bottom sections shall be cast with the bottom end flat to provide bearing of the full wall thickness. Openings for sewer pipe shall be cast in the manhole and the bottom section by the manufacturer.
- D. Riser sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets.
- E. Eccentric cone sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets and be provided with 4-stud inserts cast in the top. The top shall have a smooth finished surface.
- F. Concrete grade rings shall have smooth finished top and bottom surfaces. Grade rings shall be provided with "O" ring gaskets.

2.15 Manhole Steps

- A. Cast iron manhole steps shall be ASTM A48, Class 35, with a minimum cross section dimension of 1-inch (25 mm) in any direction.
- B. Steel Reinforced plastic manhole steps shall be suitably approved co-polymer polypropylene conforming to ASTM D4101, PP0344B33534Z02 with 1/2 inch (12 mm) minimum diameter deformed reinforcing bar conforming to ASTM A615, Grade 60 and shall be in accordance with ASTM C478.
- C. Manhole steps shall be of types and sizes indicated on the Plans and shall comply with applicable state and federal occupational and safety standards.

2.16 Covers and Frames

- A. Structure frame and covers shall be of the types and sizes as detailed on the Plans. Covers shall be Class 30, ASTM A48 gray iron castings. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of castings shall be ground to assure proper fit and to prevent rocking.

2.17 Valve Boxes

- A. Three-piece, 5-1/4-inch (135 mm) diameter, screw type, gray iron castings conforming to ASTM A48, Class 20 with adjustable length. Lids shall have "Sanitary Force Main" plainly cast in tops.

2.18 Concrete

- A. In accordance with MDOT Section 701, use Grade S2; 3,500 psi (24 MPa) strength; Type IA cement; 6.0 sacks cement per cubic yard (355 kg/m³); 6A coarse aggregate; 2NS fine aggregate; 5% ±1% air content; 3-inch (75 mm) maximum slump; no admixtures without the ENGINEER's approval.

2.19 Concrete Reinforcement

- A. In accordance with MDOT Section 905, use ASTM A615, Grade 60 for bars and ASTM A185 for welded wire fabric.

2.20 Restraints, Clamps, Rods, and Ties

- A. Cast iron or stainless steel as recommended by pipe manufacturer. Bolts, nuts, clamps, rods, ties and fittings shall be bronze alloy or corrosion protected steel.

2.21 Tracer Wire

- A. Copper clad steel wire with 30 mil High Density Polyethylene (HDPE) insulation. Concentric copper cladding metallurgically bonded to a steel core through a continuous solid cladding process.
- B. Copper cladding to measure 3% minimum of the overall wire diameter. Wire to be 12 AWG, 0.0808 in. diameter, 0.00242-inch nominal copper thickness, 9.5270 ohms nominal resistance per 1,000 feet, 675 pounds breaking strength.
- C. Wire to be Copperweld® or equal.

2.22 Acceptable Manufacturers

- A. PVC Pipe Transition Gland or Gasket: Acceptable manufacturers include Mueller, Tyler, or equal.
- B. Combination Air Valves: Acceptable manufacturers include Apco, Val-matic, or equal.
- C. Valve Boxes: Acceptable manufacturers include Clow "F-2450," or equal.
- D. Restrained Joints: Acceptable manufacturers for restrained joints for ductile iron pipe include Griffin Pipe Products Company, "Snap-Lok" or "Bolt-Lok"; American Cast Iron Pipe Company, "Lok-Ring" or "Lok-Fast"; United States Pipe and Foundry Company, "TR Flex"; Ebaa Iron "Megalug" or ENGINEER approved equal.
 - 1. Manufactured in accordance with ANSI/AWWA C111.
 - 2. A tightly adherent, corrosion resistant coating shall be used on all exposed metal components of the restrained joint system.
 - a. Wedges, actuating hardware or other exposed threaded components shall be coated with a minimum of two (2) coats of fluoropolymer epoxy coating that has been heat cured.
 - b. Primary restraint castings shall be coated with a polyester coating, electrostatically applied and fusion bonded.
 - c. Bolts, nuts, and washers shall be manufactured of low-alloy steel conforming with the material characteristics listed in ANSI/AWWA C11 and shall have a minimum of two (2) coats of fluoropolymer epoxy coating that has been heat cured.
- E. Fittings for IPS/PVC Pipe: Harco manufactured by the Harrington Corporation.

Part 3 Execution

3.01 CONTRACTOR's Verification

- A. Prior to the installation of any force main piping or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work. Ascertain that excavation bottoms, compacted subgrades and pipe bedding are adequate to receive force main materials to be installed. Correct defects and deficiencies before proceeding with the Work.

3.02 Preparation of Pipe Ends

- A. Remove all lumps, blisters and excess coatings from the socket and plain ends of pipe. Wire brush and wipe clean the outside surfaces of plain ends and the inside surfaces of socket ends before installation. Pipe or fitting which has acquired a coating of mud or other adhesive foreign material shall be scrubbed clean.

3.03 Examination of Materials

- A. Pipe fittings, accessories, and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged materials shall be rejected and removed from the Project by CONTRACTOR.

3.04 Installation - General

- A. Foreign matter shall be prevented from entering the pipe while it is being placed in the trench. During and after laying operations, no debris, clothing or other materials shall be placed in the pipe. Plug pipe ends when construction stops overnight or for extended periods.
- B. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes.
- C. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles, shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the pipe materials being cut and according to the best trade practices.
- D. When cutting pipe or fittings, care shall be taken to prevent damage to linings and coatings. Damage to linings shall be cause for rejection of the complete Section. Damage to exterior coatings shall be corrected to original Specifications.
- E. Where pipe using a resilient gasket to affect the seal is cut, the cut pipe end shall be tapered at a 30-degree angle with the centerline of the pipe, and ground smooth, on the outside end to remove any sharp edges or burrs which might damage the gasket.
- F. Provide restrained joints meeting this specification and as recommended by the manufacturer. Connection shall be made in accordance with manufacturer's recommendations.
- G. After the bottom of trench has been excavated, the pipe bedding material will be installed in accordance with Section 31 2333, Trenching and Backfilling. Pipe shall then be installed strictly in accordance with the manufacturer's recommendations.
- H. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 2333, Trenching and Backfilling. Particular care shall be taken to assure filling and tamping spaces under, around and above the top of the pipe.
- I. A continuous and uniform bedding as specified in Section 31 2333, Trenching and Backfilling, shall be provided in the trench for all buried pipe.
- J. Unless otherwise specified, pipe shall be laid with bell ends facing in the direction of laying. After a length of pipe is placed in the trench, the spigot shall be centered in the bell end of the adjacent pipe section, the pipe shoved into position and brought to true alignment and secured. Adequate support shall be provided for all force main pipe.
- K. Backfill shall be as indicated on the Plans and as specified in Section 31 2333, Trenching and Backfilling.
- L. Fittings, plugs, adapters, and horizontal and vertical blocking shall be installed by CONTRACTOR as shown on the Plans; and the cost of the same shall be included in the unit price per lineal foot of force main.

3.05 Installation of Ductile Iron Pipe

- A. Push on joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be pre-lubricated before installation using a lubricant recommended by the pipe manufacturer. Seated joint shall be identified by the visible mark on the spigot of the installed pipe section.

- B. When the temperature is above 60 degrees Fahrenheit (15 degrees Celsius), the spigot end of each pipe lead shall be forced tightly on the bell of the proceeding pipe. When the temperature is below 60 degrees Fahrenheit (15 degrees Celsius), the pipe shall be laid with the spigot end 1/16-inch (1 mm) from the face of the bell for expansion.
- C. Mechanical joints shall be made with bolts, molded resilient gasket and cast iron follower gland. Nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall be brought up evenly at all points around the bell flange and then torqued per the manufacturers recommendations.
- D. Exposed portions of bolts shall be covered with mastic.
- E. Flexible joint pipe shall be assembled, handled and installed in accordance with the printed recommendations which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to ENGINEER.

3.06 Installation of Concrete Pipe

- A. Concrete pipe and fittings shall be jointed by means of a resilient gasket and steel spigot ring. Resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe.
- B. Pipe shall be laid in accordance with the accepted tabulated laying schedule and the Plans.
- C. Short lengths of pipe (ten (10) feet or less) (3 m) specified under Article 1.05 of this Section shall be installed and evenly distributed along the line of the Work, if required.
- D. Bell of the pipe in place shall be cleaned and properly lubricated and pipe section installed. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final shape, prior to driving the pipe home, check each gasket for proper position around the full circumference of the joint and complete installation.
- E. Provide cloth bands wired around each joint outside diameter and grout with Portland cement mortar grout. Completely fill the annular recess between the adjoining bell and spigot pipe ends. Annular spaces between pipe ends on the inside of joints of pipe 24 inches (600 mm) or more in diameter shall be filled with Portland cement mortar grout.

3.07 Installation of Polyvinyl Chloride Pipe

- A. Polyvinyl chloride pipe shall be laid with gasketed joints in complete accordance with the pipe manufacturers published instructions. Joints shall be sufficiently lubricated using the pipe manufacturers recommended lubricant.
- B. Gaskets for pipe joints shall be inserted with the painted edge facing the end of the bell. Each length of pipe shall be pushed home individually. Pipe shall be positioned so that the reference mark on the spigot end is in line with the bell end.
- C. When called for on the plans or in the specifications, tracer wire is to be installed along with the force main. Tracer wire is to be continuous from end to end and terminate at each structure in such a way and with a sufficient length of wire to allow for easy connection to utility tracing equipment. Wire shall be continuity tested after installation. Any wire which fails the continuity test shall be replaced.

3.08 Subaqueous Pipe

- A. Provide sections of pipe with joints for subaqueous trench installation as indicated on the Plans. Sections of pipe shall be assembled, bedded and backfilled before connecting to land lines. Sections shall be assembled on shore, then dragged or floated into position for installation. Joints of pipe lengths and connections to land lines shall be in accordance with manufacturer's recommendations.

3.09 Installation of Restrained Joints

- A. Restrained joints shall be provided where indicated on the plans. Joints shall be assembled in strict accordance with manufacturer's directions. Joints shall be fully extended after assembly.

3.10 Polyethylene Encasement

- A. Where called for on the plans, ductile iron fittings and pipe shall be encased in a polyethylene film tube. Polyethylene film tube shall be installed in accordance with ANSI/AWWA C105/A21.5, Method A. Method A consists of cutting the polyethylene tube two feet (600 mm) longer than the pipe to provide an overlap at the joints. Cost of the polyethylene encasement shall be incidental to the water main.

3.11 Anchors and Thrust Blocks

- A. Anchors, encasements and restraints shall be provided at the locations and dimensions as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. Bearings shall be as shown. Anchors, encasements and restraints shall rest on firm, stable, compacted bedding and shall be provided for standard and special fittings.

3.12 Valves

- A. Valves shall be installed to the grade, lines, levels and locations indicated on the Plans.
- B. Valve connections shall be as specified for the piping materials used. Valves shall be set with the stem plumb on permanent, firm foundations as indicated on the Plans.
- C. Where required, valves shall be supported with special supports as indicated on the Plans and as approved by ENGINEER. Valves shall be installed so as not to receive support from the connecting pipe. In no case shall valve installation be used to bring misaligned pipe into alignment.
- D. Provide all materials and install air release and vacuum release valve assemblies at locations indicated on the Plans. Include all valves, reducers, connections and other fittings necessary for installation. Fittings and joint materials shall be compatible to the force main piping material.

3.13 Valve Boxes

- A. Install valve boxes to the grade, lines, levels and locations indicated on the Plans. Valve boxes shall not transmit shock or stress to the valve and shall be set plumb with covers centered over operating nuts and flush with the indicated surface elevations. Valve boxes that shift or fill during backfilling shall be uncovered and reset.

3.14 Structures

A. Construct structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment rings, etc., as shown and as required for a complete installation. Construction of structures shall conform to the type of construction and dimensions indicated on the Plans and as described below.

1. Brick Structures:

- a. Prior to laying, all brick shall be thoroughly wetted and the surfaces allowed to dry only sufficiently to prevent slippage on the mortar.
- b. Broken or chipped brick shall not be used on the faces of the structures.
- c. Brick shall be laid in neat, even consecutive courses with full and close mortar joints.
 - (1) Courses shall be level throughout, except as shown or otherwise required.
 - (2) Stagger joints in adjoining courses by one-half a brick as nearly as practicable.
 - (3) At least 1 course in every 7 shall be stretcher courses with intervening courses laid as headers.
 - (4) Length of brick closure pieces shall be not less than the width of 1 whole brick and, wherever practicable, closures as headers, shall be made from whole brick.
- d. Unless otherwise indicated, joints shall be not more than 1/2 inch (10 mm) thick and shall be of a uniform thickness throughout the structure. Joints shall be provided as indicated on the Plans.
 - (1) Exposed surfaces shall be true and smooth.
 - (2) Rake all joints to receive plaster coat.
- e. Prior to applying plaster coat, brick shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

2. Block Structures:

- a. Construct concrete block structures in the locations and according to the details on the Plans.
 - (1) The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar.
 - (2) Mortar joints shall be full and close in all courses.
 - (3) Courses shall be level throughout.
 - (4) Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable.

- b. Joints shall be uniform in thickness throughout the structures. Strike joints and properly point to provide true, smooth surfaces.
3. Precast Structures:
- a. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide 2 to 4 courses of 3-inch (75 mm) brick at top of structure for future adjustment.
 - b. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick or block force main structures indicated on the Plans. Plaster coat shall be 1/2 inch (10 mm) thick and shall be applied to the outer surfaces of the structures.
 - c. Provide and install to the elevations shown all cast iron covers, frames, adjusting rings, anchors, etc., indicated on the Plans and as required. Castings shall be set in a full bed of cement mortar 1/2-inch (10 mm) thick minimum. Mortar joints shall be struck smooth.
 - d. Install steps on 16-inch (400 mm) centers (minimum) for structures of types and in locations indicated on the Plans.
 - e. Pipe placed in structures for inlet or outlet connections shall extend through the walls and beyond the outside wall surfaces a sufficient distance to allow for complete connections. Openings between pipes and walls shall be sealed with a full bed of cement mortar. Pipe shall be supported by concrete supports.

3.15 Hydrostatic Testing

- A. After the pipe has been laid and backfilled, the pipe shall be hydrostatically tested for leakage.
- B. CONTRACTOR shall furnish the pump, pipe connection, blow-off valves and all other necessary apparatus including gages and meters and personnel necessary for conducting the test.
- C. Before applying the test pressure, all air shall be expelled from the pipe. If necessary, threaded taps shall be made at the points of higher elevation and then closed with brass plugs.
- D. Faulty pipe fittings, valves or other accessories which permit leaks during testing shall be replaced by CONTRACTOR with sound material and the test shall be repeated until specified requirements are met.
- E. When practicable, tests shall be made on sections between valves, or sections not exceeding 2,000 feet (610 m) in length. Dead ends, bends and other fittings shall have a firm foundation and be securely blocked against the trench walls before testing or completing the backfill as specified.
- F. Full test pressure shall be held for no less than one (1) hour or longer as necessary to permit thorough examination of all exposed joints in the section of main being tested. Test pressure shall be maintained at 150 psi (1000 kPa) for force mains.
- G. Leakage shall be measured by the quantity of water pumped into the pipe to maintain test pressure during test period. Leaks shall be located and repaired until the test meets the

the minimum requirements stated herein. Maximum permissible leakage of force main shall not exceed the following:

Force Main Diameter inches (mm)	Allowable Leakage gallons/1,000 feet/hour (liters/0.5 km/hour)
4 (100) or less	0.5 (3.0)
6 (150)	0.75 (4.5)
8 (200)	1.00 (6.0)
10 (250)	1.25 (8.0)
12 (300)	1.50 (9.0)
14 (350)	1.75 (11.0)
16 (400)	2.00 (12.5)
18 (450)	2.25 (14.0)
Force Main Diameter inches (mm)	Allowable Leakage gallons/1,000 feet/hour (liters/0.5 km/hour)
20 (500)	2.50 (15.5)
22 (550)	2.75 (17.0)
24 (600)	3.00 (18.5)

3.16 Water for Testing

- A. Water for testing shall be obtained from a water source approved by ENGINEER. CONTRACTOR shall provide all water required at his own expense and shall make necessary arrangements with the authority which controls the source of water system and shall be governed in his use of water by all rules and regulations imposed thereon by said authority.
- B. CONTRACTOR shall provide and remove temporary connections between the source water system and the mains constructed under this Contract.
- C. Temporary connections shall meet the approval of ENGINEER, the authority controlling the source water system and authorities having jurisdiction.
- D. Water for testing shall be removed from the force main by pumping to waste. Water discharge shall be controlled adequately to protect any surface water resource or adjacent property from potential environmental damage or from creation of hazard to traffic.

3.17 Flushing Force Main

- A. Should the force main flows not meet design requirements, CONTRACTOR shall flush the force main at no additional cost to OWNER.
 - 1. Flushing shall be done using the "poly-pig" method of flushing and CONTRACTOR shall furnish foam "poly-pig" swabs to be used.
 - 2. Prior to pigging and flushing, the force main must be charged with water.
 - 3. CONTRACTOR shall insert "poly-pig" swab in the end of the new main nearest the pump station (or where shown on the Plans).
 - 4. The swab shall be passed through the new main using water pressure.

5. The swab shall be recovered at the end of the main or cleanout.

End of Section

Division 40
Process Interconnections

Section 40 9000

Process Instrumentation, Controls and Monitoring Equipment - General Requirements

Part 1 General

1.01 Scope of Work

- A. This Section encompasses general provisions relating to instrumentation work. Work included in this Section pertains to all instrumentation work contained in Division 22, Division 23, Division 26, or Division 40, unless modified therein, as though this Section was repeated in its entirety in each Section.
- B. Furnish labor, materials, equipment and accessories required to provide complete operating instrumentation at the facility as described in the specifications, listed on the schedules and shown on the Drawings.
- C. Install and/or connect furnished equipment, including equipment furnished by others, as detailed herein and as shown on the Drawings.
- D. It is the intent of these Contract Documents that the instrumentation shall be suitable in every way for the service required. Material and all work that may be reasonably implied as being required for a complete fully functioning, automated and manually controlled facility shall be furnished at no extra cost.
- E. Make field connections to process instruments and other equipment furnished under this Contract; to equipment furnished by OWNER under separate contract, if any; and to reworked or relocated existing equipment as in the Contract Documents.
- F. Provide mounting, mount, and wire process instruments furnished under Contract. Furnish wire, and interconnections between process instrumentation primary elements, transmitters, local indicators, and receivers. Mount and wire surge protection equipment where indicated on the Drawings.
- G. Provide mounting, mount, and make field connections to "packaged" instruments furnished under this Contract. Electrically or pneumatically connect "package" control systems to other related panels or instrumentation defined by the Contract Documents.
- H. Process Instrumentation equipment and materials furnished under this Contract, shall be installed under Division 40. This installation Work shall include mounting, and making of process and signal connections to the equipment. This Work, with the exception of factory-mounting of certain instruments, shall be performed under the supervision of a qualified representative of the vendor of the system or equipment. This installation Work and the completed installation shall be in compliance with instructions of the above mentioned vendor's representative and in accordance with the Drawings and documentation prepared by the vendor of the system or equipment and approved by ENGINEER.

1.02 Related Work Specified Elsewhere

- A. N/A

1.03 Responsibilities

- A. CONTRACTOR shall assume responsibility to take field measurements of related and connecting work, and to determine the entire scope of the work required for a finished and completed project, in accordance with the Contract Documents and as approved by ENGINEER.
- B. Drawings upon which this Contract is based show the arrangement, general design and extent of the systems and components. Systems are suitably outlined on the Drawings with regard to size, locations, general arrangements and installation details. Connections are shown in diagram form, except where in certain cases the drawings may include details giving the exact locations and arrangements. Drawings shall not be scaled to determine location. Work shall be installed in such a manner to avoid interferences.
- C. Where any parts of the systems or piece of equipment are located by dimensions on the Drawings, said dimensions shall be checked and verified in the field. Should discrepancies or interferences occur which will necessitate major revisions in the work, ENGINEER shall be notified immediately and his authority secured in writing for such revisions before proceeding with the Work.
- D. Drawings are intended to convey the desired method of control and operation of the instrumentation and control system. CONTRACTOR shall retain the services of the Control System Supplier to be responsible for the system analysis, design and functional adequacy of equipment necessary to achieve required systems performance and to satisfy the intent of these Contract Documents.
- E. Instrumentation and controls shall be installed under the supervision of the Control System Supplier. Insofar as possible, instrumentation and control equipment shall be furnished from a single supplier. CONTRACTOR shall retain the services of the Control System Supplier to supply the complete control and instrumentation system and prepare wiring diagrams, installation drawings and changes for existing equipment.
- F. Modifications or additions to the electrical conduit and wiring installation for the instrumentation and control system required by the instrumentation and control system and not shown on the Contract Drawings shall be furnished and installed by CONTRACTOR, as approved by the equipment manufacturers. Other devices or wiring including energy sources and/or converters necessary to obtain proper operation of the instrumentation and control system, shall be provided and installed by CONTRACTOR. Special interface equipment required shall be provided and installed by CONTRACTOR at no additional cost to OWNER.

1.04 Reference Standards

- A. Equipment, materials, and systems provided shall be designed, manufactured, finished, painted, tested, inspected, packaged, shipped, stored, installed, connected, and tested in accordance with the General Industry Standards of OSHA, MIOSHA, and local, county, state, and federal laws; and in accordance with the published codes, standards, and specifications of the following organizations:
 - 1. ANSI - American National Standards Institute
 - 2. ASTM - American Society for Testing and Materials
 - 3. AWWA - American Water Works Association

4. IEEE - Institute of Electrical and Electronics Engineers
5. ISA - Instrument Society of America
6. MIOSHA - Michigan Occupational Safety and Health Administration
7. NEC - National Electric Code
8. NEMA - National Electrical Manufacturers Association
9. NFPA - National Fire Protection Association
10. OSHA - Occupational Safety and Health Administration (U.S. Depart. of Labor)

B. Equipment, materials, and systems shall be U.L. labeled or listed except for classes of materials and equipment not available with such listing.

1.05 Guarantee and Warranties

A. Guarantee work in accordance with the requirements of the Conditions of the Contract. With respect to instruments and equipment, guarantee shall cover:

1. Faulty or inadequate design
2. Improper assembly or erection
3. Defective workmanship or materials
4. Leakage, breakage, or other failure not caused by OWNER misuse.

B. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty with OWNER named as beneficiary.

1.06 Improvements

A. Manufacturer's improvements involving specified systems or equipment needed to fulfill the intent of these specifications, and required to fulfill functionally the operational requirements, shall be provided at no additional cost to OWNER.

1.07 Submittals

A. Shop Drawings and Product Data:

1. Certified drawings and diagrams for all instrumentation and control work shall be furnished by CONTRACTOR and delivered to ENGINEER in accordance with Section 01 3300, Submittal Procedures. Information to be submitted for approval shall include:
 - a. Schematic Wiring Diagrams
2. CONTRACTOR shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.
3. Drawings shall be 24" x 36" mylar with border, title block, symbols, etc., as used on the Contract Drawings and approved by ENGINEER. Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc. Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.
4. Where applicable, and if CONTRACTOR desires, he may purchase mylars, vellums or electronic files (when approved by ENGINEER) of the process control drawings from ENGINEER, modify these drawings as required, and utilize them as shop drawings.

5. Bond copies will be acceptable for the approval issue only.
6. Manufacturer's specifications complete with descriptive information indicating design data underscored to assist in verification that equipment proposed is equal to or exceeds the technical requirements and intent of these specifications. Design data shall cover exact equipment furnished.
7. Dimensional outline drawings of all control and instrument enclosures including designated conduit or wireway entrances, internal equipment layouts and structural details.
8. Internal wiring diagrams of control enclosures identifying terminals and showing external and interconnecting terminals and field mounted devices.
9. Details necessary for fabrication of equipment specific to these control systems.
10. Working and/or construction drawings, showing conduit layout, locations, details, size, wire size and type and cables therein.
11. Technical information for all devices furnished.
12. Cable schedule detailing each cable, routing and all connections, as described in a format approved by ENGINEER.
13. A riser diagram shall be provided showing all cables, wires and conduits.
14. A complete list of all recommended spare parts and test equipment required for the upkeep of all instruments and controls devices installed under this Contract.
15. Complete parts lists of all materials and components incorporated in the system.
16. Individual manufacturer's instruction manuals for all devices.
17. CONTRACTOR shall submit as-built drawings, instruction manual material and assistance as required by Sections 01 7700, Closeout Procedures.

1.08 Shipping Precautions

- A. After completion of shop assembly and tests, all control cabinets, panels and consoles, etc., shall be enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture.
- B. Dehumidifiers or desiccant materials shall be placed inside the polyethylene coverings prior to sealing. Equipment shall then be skid mounted and braced for final transport.
- C. Lifting rings shall be provided for moving without removing protective coverings on all sections weighing more than 150 lbs. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling.
- D. Equipment provided under this Contract shall not be delivered to the job site until scheduled for installation.
- E. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.

- F. Each package shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on outside of package.
- G. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, shall be provided on each piece of equipment supplied under the Contract.

1.09 Storage

- A. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters and shall be adequately protected against mechanical injury or damages by water.

1.10 Instrument Identification

- A. Major instrumentation and equipment items or system specified shall be identified by system and tag numbers. This same number appears in the tag number designations on the drawings and on the schedule.
- B. Instrumentation and equipment shall be identified by nameplates or tags.
- C. Nameplates for panels and panel mounted equipment shall be as specified in the respective Section.
- D. Field equipment shall be tagged with assigned instrumentation tag number and function.
 - 1. Tags shall be white lamacoid with engraved black characters of 3/16 inch minimum height.
 - 2. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard hose clamps and meeting the same description. In cases where this would be impractical, use 20 gage stainless steel screws installed in an unobtrusive manner.
- E. In addition to tags, field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed.
 - 1. Nameplate shall be attached by one of the above methods.

1.11 Signal Isolators, Converters, and Conditioners

- A. Ensure that input-output signals of all instruments and control devices are compatible.
- B. Unless otherwise specified, signals between field and panels shall be 4 to 20 mA DC unless specifically approved otherwise.
- C. Granting such approval does not relieve the compatibility requirement above.
- D. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices inside or behind control panels, or in the field at point of application.

1.12 Process Connections

- A. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance.
- B. Slope lines according to service to promote a self draining or venting back to the process.
- C. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shutdown of the process.
- D. Include drip legs and blow-down valves for terminations of sensing lines at the instruments when mounted in such a way that condensation can accumulate.
- E. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished by CONTRACTOR.

1.13 Manufacturer's Service

- A. General:
 - 1. CONTRACTOR shall furnish the services of a factory representative of the instrumentation equipment manufacturer to provide field supervision during installation, to direct the installation of the equipment, and to conduct initial equipment checkout and system start-up.
 - 2. CONTRACTOR shall furnish the services of a factory trained and qualified serviceman of the manufacturers of the instrumentation equipment and accessories supplied under this Contract to perform the following:
- B. Supervision:
 - 1. Supervisory service of a trained serviceman, specifically trained on the type of equipment herein specified, shall be provided during construction to assist in, location of sleeves, methods of installing conduit and special cable, mounting piping and wiring for each type of device, and the methods of protecting all of the equipment prior to placing it in service.
- C. Power Check-Out:
 - 1. Checking the installation of all components before power is applied.
 - 2. No form of energy shall be applied to any part of the instrumentation system prior to receipt by ENGINEER of a certified statement of approval of the installation from CONTRACTOR, containing his Control System Supplier's authorization for turning on energy to the system.
- D. Check-Out:
 - 1. Placing the equipment into operation and making necessary adjustments including tests and loop checks.
 - 2. CONTRACTOR shall provide the Control System Supplier's services to maintain all control system equipment in good operating condition and furnish on-call maintenance as required to minimize equipment down time, until the project has attained Substantial Completion.

- a. Control System Supplier shall provide scheduled preventative maintenance based on ENGINEER approved listing specifying the time required for preventative maintenance on the various types of equipment and shall provide remedial maintenance services as required.
- b. Additional service time shall be provided during the one-year warranty period for at least three 8-hour day service visits to the site to check and readjust the equipment supplied under this Section.

1.14 Tools and Spare Parts

- A. One complete sets of any specialty instrument required to adjust and calibrate the instrumentation equipment shall be furnished with the equipment.
 1. They shall include hand tools for maintenance and calibration such as: unique screwdrivers and wrenches plus other tools as required.
 2. They shall be supplied in a durable case.
 3. Calibration tools for instrumentation equipment such as magmeters, flowmeters, and pneumatic instruments shall also be provided.
- B. A universal, portable input-output calibrator shall be provided.
 1. The unit shall be suitable for use as a current or voltage source, current or voltage measuring device and as a power supply for two wire transmitters.
 2. Output section shall contain 6 current and 5 voltage ranges.
 3. Internal power supply shall contain 3 ranges.
 4. A self contained portable potentiometer shall also be provided.
 5. Tester shall be Fluke model 789 or ENGINEER approved equal.

1.15 Spare Parts

- A. Spares consumed during installation and testing shall be replaced by CONTRACTOR prior to final acceptance of the system.
- B. Control System Supplier shall supply a complete list of all suggested spare parts and supplies he considers required for the continuous operation of the system.
 1. List shall include catalog and serial numbers of the hardware devices, spare parts part numbers, commercial part numbers and price in effect when the list is prepared.
 2. Spare parts shall be 100% of the manufacturer's recommended spare parts for each device.
- C. Spare parts for specific equipment, if necessary to be furnished by CONTRACTOR, shall be specified in the Sections for the specific equipment.

1.16 Source Quality Control

- A. Instruments and controls shall be installed under the supervision of Control System Supplier.
 - 1. In order to ensure a coordinated instrumentation and control system, CONTRACTOR shall require the Control System Supplier to certify coordination of the overall control and instrumentation system so that all devices provided under this Contract are compatible and provide a complete and operable system.
 - 2. Control System Supplier shall inspect each component piece of equipment supplied for each system to assure that it is new, in good working order and complies with the intent of Contract Documents.
 - 3. Components not fulfilling these criteria shall be rejected.

Part 2 Products

2.01 Instrumentation General

- A. Electronic instrumentation shall be of the solid-state type, of manufacturer's latest design; preferably designed and packaged for miniature, high density mounting configuration.
 - 1. Where available, the instruments will be supplied with self-supporting, draw-out feature when in extended position.
 - 2. Transmitted analog signals shall be 4-20 mAdc; however, signals between instruments within the same panel/cabinet may be 1-5V.
 - 3. Zero base transmission signals will not be allowed, only "live zero" signals. An exception would include outputs of sensing devices specified hereafter, however, converted to compatible high level signals for remote transmission.
- B. Field mounted equipment shall be in NEMA 4X enclosures and, if required, shall include suitable strip heaters to prevent accumulation of moisture.
- C. Equipment installed in hazardous areas, shall meet Class I, Group D, Division I to comply with the National Electrical Code.
- D. Indicators and recorder readouts will be linear in process units.
- E. Transmitters shall be provided with either integral indicators or separately mounted indicators reading in process units. Special features listed in the individual instrument specifications are required and all information listed therein shall be considered as minimum requirements.
- F. Equipment furnished shall be approved for specific application by Underwriter's Laboratories, Inc., or Factory Mutual if applicable.

2.02 Electrical

- A. Refer to Division 26.

- B. Equipment shall be designed to operate on a 60 Hertz alternating current power source at 105 to 135 volts, except as noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- C. Switches shall have single-pole double-throw contacts rated at 600 VA.
- D. Contacts for low voltage signals shall be gold flashed.

2.03 Power Failure

- A. Equipment shall be designed and constructed so that in the event of a power interruption the equipment shall resume normal operation without manual resetting when power is restored.

2.04 Control System Suppliers

- A. Available Control System Suppliers: Subject to compliance with requirements, provide a Control System Supplier of the following:
 - 1. Aggressive Systems, Inc.
 - 2. Commerce Controls, Inc.

Control System Supplier. Equipment specified and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to job site, and started up by a qualified and approved Control System Supplier listed under this heading. Intent is for unit responsibility.

- B. Control System Supplier shall not assign any of his rights or delegate any of his obligations.
- C. Direct purchase of any items by CONTRACTOR is not in compliance with this Specification and will not be permitted.
- D. Control System Supplier shall assign a qualified representative to act as Project Engineer for the work efforts specified. Control System Supplier shall submit a resume outlining the qualifications of this individual to ENGINEER for approval within 3 days of notice to proceed. Project Engineer shall, at a minimum, have the following qualifications:
 - 1. Successfully completed vendor factory training for the digital equipment supplied.
 - 2. Successfully completed projects of similar size and complexity.
- E. Project Engineer shall be interviewed at ENGINEER's office in Taylor, Michigan after the contract has been awarded. Individuals selected as Project Engineer must be approved by ENGINEER. Individuals not approved by ENGINEER shall not function as Project Engineer.
- F. Project Engineer shall be the focal point for all design, fabrication, contract communications, and construction and shall be responsible for start-up and acceptance.
 - 1. The Project Engineer shall be at the factory test, at the job site during the entire construction process start-up, and at the job site during the entire acceptance procedure.
 - 2. Only qualified and approved Control System Suppliers will be accepted as meeting this Specification.

3. The Control System Supplier shall also assign a full-time service technician during the construction process effort to assist in verifying and making minor corrections to wiring which may be necessary as determined by ENGINEER.
 4. The start-up/acceptance procedure shall not begin until all installation has been completed and any punch list items are minor in nature.
- G. Installation and Start-up. Control System Supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time by ground from the jobsite.

2.05 Training

- A. General:
1. CONTRACTOR shall provide two 8-hour days of training of OWNER's personnel in aspects of operation and maintenance such as direction on calibration of field instruments, fuse locations, instruction manuals, etc.
 2. At-the-plant training and instructions shall be given by the Project Engineer assigned to the project by the Control System Supplier or other personnel as approved by ENGINEER.
- B. Digital Equipment:
1. Control System Supplier shall provide comprehensive instruction for the programmable controllers and software packages supplied. This instruction shall be performed by the manufacturer of the products at their factory training facility.
 2. CONTRACTOR shall submit to ENGINEER, an outline of the proposed training courses to meet the requirements set forth below.
 - a. Hardware training (3 individuals)
 - (1) 1 day, Maintenance and Troubleshooting
 - b. Software training (3 individuals)
 - (1) 1 day, Software Concepts
 3. CONTRACTOR shall also provide to ENGINEER a list of additional courses available from the manufacturer.
 4. Upon review, ENGINEER may request that a substitution be made of a course content that better fits the needs of OWNER.
 - a. Such substitution shall only be requested for courses of equal length cost and availability. The content of these courses and proposed lengths shall be as follows:
- C. OWNER shall determine actual division of attendance. Written course materials shall be included along with hands-on exercises with instructional equipment. Factory training shall be conducted on a schedule acceptable to OWNER and shall commence prior to system factory testing.

- D. For training conducted at other than OWNER's facilities, CONTRACTOR shall bear all transportation (air fare, car rental, etc.) and subsistence (hotel, meals, etc.) costs for training.
 - 1. Daily subsistence allowance shall be \$150/day/person.
 - 2. CONTRACTOR shall arrange for all training for OWNER with a minimum of 6 week notification of training schedule prior to actual course being provided.
 - 3. Scheduling of courses and their contents shall be approved by ENGINEER and provided at a time and location agreeable to OWNER.
 - 4. Course shall be conducted at locations normally established for such courses by manufacturers of software and computer products.

Part 3 Execution

3.01 Inspection

- A. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of instruments and equipment.

3.02 CONTRACTOR's Certified Reports

- A. CONTRACTOR shall submit a certified report for control panel and associated field instruments certifying that the equipment:
 - 1. Has been properly installed under Control System Supplier's supervision.
 - 2. Is in accurate calibration.
 - 3. Was placed in operation in under Control System Supplier's presence.
 - 4. Has been checked, inspected, calibrated, and adjusted as necessary.
 - 5. Has been operated under maximum power variation conditions and has operated satisfactorily.
 - 6. Is fully covered under the terms of the guarantee.

3.03 Demonstration and Final Operating Test Plans and Results

- A. Submit for approval, a written plan for demonstrating that each system of equipment provided meets the specified operational requirements.
 - 1. The plan shall include procedures to be used in final operational testing of entire system including description for each system of test methods and materials, testing instruments and recorders, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary bypasses and like facilities.

3.04 Preparation

- A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

3.05 Installation

- A. Instrumentation and accessory equipment shall be installed in accordance with the Control System Supplier's instructions.
 - 1. Locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by ENGINEER during construction.
 - 2. Field verify information relevant to the placing of process control equipment and in case of any interference, proceed as determined by ENGINEER.
 - 3. Furnish labor and materials necessary to complete the work in an approved manner.
- B. Instrumentation loop diagrams on the Drawings indicate the intent of the interconnection for the instruments specified.
 - 1. Work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, CONTRACTOR shall bear full responsibility for such violations and assume all costs arising there from.
 - 2. Field instruments requiring power supplies shall be provided with local electrical shut-offs.
- C. Brackets and hangers required for mounting of equipment shall be provided and shall be installed in a workmanlike manner so as to not interfere with other equipment.
 - 1. CONTRACTOR shall investigate each space in the building through which equipment must pass to reach its final location.
 - 2. If necessary, the manufacturer shall be required to ship this material in sections sized to permit passing through such restrictive areas in the building.
- D. The shield on each process instrumentation cable shall be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground be employed for each shield.
 - 1. Cable shields will be continuously maintained by termination to "shield" terminals which are not grounded except at the Main Control Panel. The sole exception is if the manufacturer requires ground of the shield at the field device.
- E. Each pair of wires shall be tagged within four inches of each termination with the assigned cable, pair and terminal numbers.
 - 1. Low energy signal (4-20 mAdc) shall be run in instrumentation cables in conduits separated from AC power, control and annunciator wiring.

2. Lifting eyes shall be removed from cabinets/assemblies.
3. Holes in cabinet or boxes shall be plugged.
4. The plug will be of the same color as the cabinet or box and shall be gasketed.

3.06 Instrument Calibration

- A. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications instructions for calibration.
- B. Each instrument shall be calibrated at 10%, 50%, and 90% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments shall have accuracies traceable to the National Bureau of Standards, as applicable.
- C. Provide a list and basic specifications for instruments used.
- D. Provide a written report to ENGINEER on each instrument certifying that it has been calibrated to its published specified accuracy.
 1. Report shall include applicable data as listed below plus any defects noted, correction action required and correction made.
 2. Data shall be recorded on prepared forms and shall include not less than the following items.
 - a. Facility identification (name, location).
 - b. Loop identification (name or function).
 - c. Equipment tag and serial numbers.
 - d. Scale ranges and units.
 - e. Test mode or type of test.
 - f. Input values or settings.
 - g. Expected outputs and tolerances.
 - h. Date of actual calibration.
 - i. Actual readings.
 - j. Explanations or special notes as applicable.
 - k. Tester's certification with name and signature.

3.07 System Validation

- A. Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance.
 1. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output.
- B. Validate each system by simulating inputs at the first element in loop (i.e., sensor) of 10%, 50%, and 90% of span, or on/off and verifying loop output devices (i.e., recorder, indicator, alarm, etc., except controllers).
 1. During system validation, make provisional settings on levels, and alarms.

2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.
 3. Verify that alarms and logic sequences operate in accordance with the specifications.
- C. Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation.
 - D. Immediately correct defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.
 - E. Provide a report certifying completion of validation of each instrument system.
 1. Report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices.
 2. Data sheets shall be similar to those used for calibration.

3.08 Final Operational Testing and Acceptance

- A. Upon completion of instrument calibration and system validation, test system under process conditions.
 1. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems.
 2. Testing shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.
- B. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat and testing.
- C. Upon completion of final operational testing, submit certified report, with substantiating data sheets, indicating that total instrumentation and control system meets the functional requirements specified herein.
- D. Testing shall be observed by ENGINEER.
 1. Notify ENGINEER in writing a minimum of 48 hours prior to the proposed date for commencing the testing.
 2. Upon completion of this test CONTRACTOR shall begin or have begun system start-up.
 3. OWNER reserves the right to set the schedule.

3.09 Start-Up Assistance

- A. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of 1 day at the project site to assist ENGINEER in field checkout and start-up of software. This period shall be scheduled by ENGINEER.

- B. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of two (2) working days to assist OWNER's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

3.10 Coordination

- A. Work shall be coordination with other trades involved in the construction project.
- B. Work shall be carefully laid out in advance so that architectural, structural, mechanical, electrical, and instrumentation features of construction will be coordinated.

3.11 Digital Equipment

- A. Digital equipment supplier shall provide an authorized, service representative for a minimum of three times at jobsite, including once during installation and start-up and once during acceptance to inspect and check out the control system.
- B. Service representative shall revisit jobsite for 8 hours per day as often as necessary after installation until trouble is corrected and equipment has passed acceptance test and is operating satisfactorily to ENGINEER.

End of Section



Qualified Disabled Veteran (QDV) Business Representation

'Qualified Disabled Veteran,' means a business entity that is 51% or more owned by one or more veterans with a service-connected disability.

'Qualified Disabled,' means a business entity that is 51% or more owned by one or more with a service-connected disability.

The vendor represents that it IS _____, a qualified disabled veteran.

The contractor represents and warrants that the company meets the above (when checked) and has attached supporting documentation per the following:

Each bid requesting the Qualified Disabled Veterans (QDV) preference, in accordance with Public Act 22 of 2010, MCL 18.1241.3 shall include a DD214 Proof of Service and Discharge, a Veterans Administration rating decision letter, proof of disability (if the disability is not indicated on the DD214), and appropriate legal documents setting forth the 51% natural persons QDV ownership.

Fraudulent Certification as a Qualified Disabled Veteran may result in debarment under MCL 18.264.

Certification of a Michigan Based Business

(Information Required Prior to Contract Award for Application of State Reciprocity Provisions)

To qualify as a Michigan Based Business:

Vendor must have, during the 12 months immediately preceding this bid deadline:

or

If the business is newly established, for the period the business has been in existence, it has:

(Check all that apply):

- Filed a Michigan single business tax return showing a portion, or all the income tax base allocated or apportioned to the State of Michigan pursuant to the Michigan Single Business Tax Act, 1975 PA 228, MCL 208.1 – 208.145 or
- Filed a Michigan income tax return showing income generated in or attributed to the State of Michigan; or
- Withheld Michigan income tax from compensation paid to the bidder's owners and remitted the tax to the Department of Treasury; or

I certify that I have personal knowledge of such filing or withholding, that it was more than a nominal filing for the purpose of gaining the status of a Michigan business, and that it indicates a significant business presence in the state, considering the size of the business and the nature of its activities.

I authorize the Michigan Department of Treasury to verify that the business has or has not met the criteria for a Michigan business indicated above and to disclose the verifying information to the procuring agency.

Bidder shall also indicate one of the following:

- Bidder qualifies as a Michigan business (provide zip code: _____)
- Bidder does not qualify as a Michigan business (provide name of State: _____).
- Principal place of business is outside the State of Michigan, however service/commodity provided by a location within the State of Michigan (provide zip code: _____).

Fraudulent Certification as a Michigan business is prohibited by MCL 18.1268 § 268. A BUSINESS THAT PURPOSELY OR WILLFULLY SUBMITS A FALSE CERTIFICATION THAT IT IS A MICHIGAN BUSINESS OR FALSELY INDICATES THE STATE IN WHICH IT HAS ITS PRINCIPAL PLACE OF BUSINESS IS GUILTY OF A FELONY, PUNISHABLE BY A FINE OF NOT LESS THAN \$25,000 and subject to debarment under MCL 18.264.



STATE FUNDED PROJECT PREVAILING WAGE PROJECTS

1. The Contractor (and its Subcontractors) represents and warrants that it pays all mechanics and laborers employed directly on the site of the work, unconditionally and at least once a week, and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the advertised specifications as prevailing wages based on locality, regardless of any contractual relationship which may be alleged to exist between the Contractor or subcontractor and the laborers and mechanics.

The Contractor represents and warrants that Contractor will post the scale of wages to be paid in a prominent and easily accessible place at the site of the work.



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DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
State Facilities Administration
Design & Construction Division

APPENDIX I

SPECIAL WORKING CONDITIONS



DEPARTMENT OF NATURAL RESOURCES

The Work comprising this Project will be performed at a site of the Department of Natural Resources. The Contractor must comply with all rules and regulations pertaining to such sites and must conform to the following rules:

1. The Contractor must provide a competent Superintendent satisfactory to the Department of Natural Resources on the work site at all times during working hours with full authority to act for him. It must be the Contractor's responsibility to furnish the Department of Natural Resources with the name, address and telephone number of the responsible person to contact for Emergency during after hour, weekend and holiday periods.
2. Access to and egress from the site must be via routes specifically designated by the Department of Natural Resources authorized representative.
3. All work will be coordinated so as to minimally interfere with the normal function of the facility which will be open and operational during construction.
- 3.1 No Work must be performed at the site on Saturdays, Sundays, holidays or during night hours without the written permission from the Department of Natural Resources.
4. Areas on the site for employee parking, toolboxes, material lay down, etc., must be assigned by the Department of Natural Resources. All firearms, weapons, alcoholic beverages, or explosives must be removed from vehicles before entering the site.
5. Heavy equipment such as bulldozers and power shovels must be locked or immobilized in an acceptable manner when not in use. No tools, small pipe, copper or wire must remain on the site overnight, unless acceptably locked inside shanties or tool chests. There will be no exchange, loaning or borrowing of tools, equipment or manpower between the Department of Natural Resources and the Contractor.
6. The Contractor must comply with the special condition requirements of the Department of Natural Resources.
7. Work Schedule: No work to be started onsite before June 15, 2026. Anticipated preconstruction kickoff meeting in mid-June. All work is to be completed during normal business days to avoid higher public traffic expected on weekends or holidays. The majority of the work at each location (Visitors Center #2 and Day Use) shall be completed during scheduled 1-week time frames. The Day Use location shall be thoroughly restored for public use on the following weekend. Ensure that all materials and/or equipment is not staged within the pavilion area or adjacent lawn area(s).



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APPENDIX II

SPECIAL PROJECT PROCEDURES

SOIL EROSION AND SEDIMENTATION CONTROL PROJECT PROCEDURES FOR CONTRACTORS

1. Comply with Part 91, Soil Erosion and Sedimentation Control (SESC) of the Natural Resources and Environmental Protection Act 1994 PA 451, as amended.
2. It has been determined that a SESC permit is NOT required based on the limited excavations. However, the contractor is still required to comply with SESC requirements on the property involved in the Work and SESC best management practices to control soil erosion and protect adjacent properties and the waters of the state from sedimentation. Should Work on State property be added to the project where excavation scope becomes larger than 1 acre or extends closer than 500 feet of a stream or lake, contact the PSC to implement a SESC plan and permit.

DEMOLITION/REMODELING PROJECT PROCEDURES

Furnish all equipment, materials, labor, and services necessary to complete all building demolition required in connection with the existing building, in order to permit the installation of new Work. The goal of the Owner is to generate the least amount of waste or debris possible. However, inevitable waste and debris that are generated shall be reused, salvaged, or recycled, and disposal in landfills shall be minimized to the extent economically feasible. The Contractor shall have a waste management plan for the collection, handling, storage, transportation, and disposal of the waste generated at the construction site.

1. Locations: Notations are made in various places on the Drawings to call attention to building demolition which is required; however, these Drawings are not intended to show each and every item to be removed. The Contractor and the Subcontractors for the various trades must remove the materials related to their respective trades as required to permit the construction of the new Work as shown.
2. Permits: The Contractor must secure from the appropriate agencies all required permits necessary for proper execution of the work before starting work on the project site. All fees for securing the permits must be paid by the Contractor, including all inspection costs which may be legally assessed by the Bureau of Construction Codes in accordance with the authority granted under the Public Act 1980 PA 371, as amended.
3. Enclosures: Where it is necessary to make alterations to walls, floors or roof of the existing building, the Contractor must provide and maintain dustproof partitions to separate the parts where Work is being done from the adjoining parts occupied by the State Agency. Where any parts are opened and exposed to the elements, the Contractor must provide weather tight enclosures to fully protect the structure and its contents.
5. Preparation: Protect all existing Work that is to remain and restore in an approved manner any such Work that becomes damaged.
 - 5.1 Rubbish and debris resulting from the Work must be removed immediately from the site by the Contractor. However, any recyclable materials must be recycled; the Contractor will be required to use alternatives to landfills for waste disposal such as reuse or recycle of asphalt, bricks, concrete, masonry, plastics, paint, glass, carpet, metals, wood, drywall, insulation, and any other waste materials to the extent practical.
 - 5.2 Unless otherwise specified, the Agency will remove existing furniture, drapery tracks, draperies, window blinds, and other equipment items, which might interfere with the new construction.
6. Coordination: Demolition work, in connection with any new unit of Work, must not be commenced until all new materials required for completion of that new item of Work are at hand.

HAZARDOUS MATERIALS PROJECT PROCEDURES

1. The Contractor must use, handle, store, dispose of, process, transport and transfer any material considered a Hazardous Material in accordance with all federal, state, and local Laws. If the Contractor encounters material reasonably believed to be a Hazardous Material and which may present a substantial danger, the Contractor must immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions. A Contract Change Order will be written to modify the existing Contract to pay for the additional hazardous materials scope.
2. This project has been identified by the DTMB-SFA as having MINIMAL possibility of containing Hazardous Waste materials to be legally removed from the Project job site to complete the Work. As deemed necessary to complete the work, coordinate with the Building Owner for their properly handling of any onsite chemical products used for normal building operations.
3. Environmental Hazards (air, water, land and liquid industrial) are handled by the Waste and Hazardous Materials Division, Michigan Department of Environment, Great Lakes, and Energy (EGLE) in carrying out the requirements of the Federal Environmental Protection Agency (EPA). For general information and/or a copy of the latest regulations and publications call (517) 335-2690.
4. The Michigan Occupational Safety and Health Administration (MIOSHA) provides protection and regulations for the safety and health of workers. The Department of Licensing and Regulatory Affairs provides for the safety of workers. The Department of Health & Human Services provides for the health of workers (517/373-3740) (TDD 517/373-3573).
 - 4.1 Contractor must post any applicable State and/or Federal government regulations at the job site in a prominent location.
 - 4.2 Contractor must be responsible for training their workers in safe work practices and in proper removal methods when coming in contact with hazardous chemicals.
5. Applicable Regulations:
 - 5.1 Natural Resources and Environmental Protection Act – PA 451 of 1994, as amended, including Part 111 – Hazardous Waste Management, Part 121 – Liquid Industrial Waste and Part 147 – PCB compounds.
 - 5.2 RCRA, 1976 - Resource Conservation and Recovery Act: This federal statute regulates generation, transportation, treatment, storage, or disposal of hazardous wastes nationally.
 - 5.3 TSCA, 1979 – Toxic Substances Control Act: This statute regulates the generation, transportation, storage, and disposal of industrial chemicals such as PCBs.
6. Definitions: Hazardous substances are ignitable, corrosive, reactive, and/or toxic, based on their chemical characteristics.
 - 6.1 Under Federal and Michigan Law, a Small Quantity Generator of hazardous waste provides from 220 to less than 2,000 lbs./month or never accumulates 2,200 lbs. or more.
 - 6.2 A Generator size provider of hazardous waste provides 2,200 lbs. or more/month or accumulates above 2,200 lbs.
7. Disposals: To use an off-site hazardous waste disposal facility, the Contractor must use the Uniform Hazardous Waste Manifest (shipping paper). Small quantities of hazardous waste may not be disposed of in sanitary landfills used for solid waste.
8. Federal, state, and local Laws and regulations may apply to the storage, handling and disposal of Hazardous Materials and wastes at each State Agency. Contact the **Environmental Assistance Center** of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) at **1-800-662-9278**, Fax to: 517-241-0673 or e-mail to: DEQ-EAD-env-assist@michigan.gov for general EGLE information including direct and referral assistance on air, water and wetlands permits; contaminated site clean-ups; underground storage tank removals and remediation; hazardous and solid waste disposal; pollution prevention and recycling; and compliance-related assistance. The Center provides businesses, municipalities, and the general public with a single point of access to EGLE's environmental programs.

ASBESTOS ABATEMENT PROJECT PROCEDURES

No known or assumed asbestos containing materials (ACM) have been identified in the building(s) or are anticipated to be removed or disturbed by the Work. If the Contractor encounters a suspected ACM, the Contractor must immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions. If, after providing Owner notification, the Contractor is directed to sample and/or remove the suspected ACM in question, a Contract Change Order will be written to modify the existing Contract to pay for the additional cost. Any abatement shall be completed in accordance with the requirements of this Section.

If removal of ACM is required, removal must be completed by a contractor currently licensed to remove asbestos by the State of Michigan, Department of Licensing and Regulatory Affairs (DLARA) Asbestos Program and abatement must be performed in accordance with all federal, state, and local Laws and Regulations. Prior to commencing any asbestos abatement activities, the licensed abatement contractor must submit, as required by Federal, State and Local Laws and Regulations, a "Notification of Intent to Renovate/Demolish" to both the State of Michigan, Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division and to the DLARA, Asbestos Program, to comply with National Emission Standards for Hazardous Air Pollutants (NESHAP), and the Clean Air Act (CAA). All regulated ACM must be disposed of at an approved Type II (general refuse) landfill and must be in leak-tight wrapping or containers. ACM that is non friable and is not in poor condition or will not become regulated ACM at any time can be disposed of in a Type III (construction debris) landfill.

At the completion of each abatement activity, the Contractor must perform clearance testing in accordance with National Institute for Occupational Safety and Health (NIOSH) 582 "Sampling and Evaluating Airborne Asbestos Dust". All air samples shall indicate concentrations of less than 0.01 fibers/cc for clearance to be met. Clearance testing shall be performed by a third-party Asbestos Consultant. The Asbestos Consultant selected by the Contractor shall be experienced and knowledgeable about the methods for asbestos air sampling and be able to select representative numbers and locations of samples. It is mandatory that the Asbestos Consultant's on-site hygienist performing sampling and analysis have certification that he/she has passed a NIOSH 582 or equivalent course.

The NESHAP asbestos regulations, notification form, guidelines and fact sheets are available on EGLE's web site www.michigan.gov/egle under heading Air; then click on Compliance; then click on Asbestos NESHAP Program. For guidelines on submitting notifications pursuant to the Asbestos Contractors Licensing Act, contact the DLARA, Occupational Health Division, Asbestos Program at (517) 322-1320 or visit DLARA's web site www.michigan.gov/asbestos.

LEAD ABATEMENT PROJECT PROCEDURES

Lead-Containing Paint materials are not known to existing at the project site. Should the Contractor encounter suspected Lead Paint, the Contractor must immediately stop all affected work, give written notice to the Owner of the conditions encountered, and take appropriate health and safety precautions. If, after providing Owner notification, the Contractor is directed to sample and/or remove the suspected lead paint in question, a Contract Change Order will be written to modify the existing Contract to pay for the additional cost. The Contractor shall take all steps necessary to assure that his/her employees, are not exposed to lead at concentrations greater than the Permissible Exposure Limit as per the State of Michigan Department of Licensing and Regulatory Affairs Occupational Health Standards Part 603 "Lead Exposure in Construction". In addition, the Contractor shall convey this same requirement to all subcontractors that may be under his/her control.

The employer shall comply with the Michigan Lead Abatement Act, as amended, and the Lead Hazard Control rules and must communicate information concerning lead hazards according to the requirements of Michigan Occupational Safety and Health Administration (MIOSHA) Part 603 and the Occupational Safety and Health Administration's (OSHA's) Hazard Communication Standard for the construction industry, 29 CFR 1926.59, including but not limited to safety equipment (e.g. personal fit-tested and approved respirators and protective clothing), worker rotation (on a short-cycle and regular basis), working practices (e.g. sanding, cutting, grinding, abraded, burning and heat-gun stripping of lead based paint are not allowed), the requirements concerning warning signs and labels, material safety data sheets (MSDS), and employee information and training. Employers shall comply with the requirements of 29 CFR 1926.62(l) - Employee Information and Training.

If lead or materials containing lead will be disturbed as a part of the work to be performed, the Contractor must remove, transport, and dispose of these materials at no additional cost to the Owner and prior to any other work taking place within the immediate vicinity of said material. The Contractor must provide the Owner a minimum 10 working day notification prior to the start of any lead abatement activities with abatement in occupied buildings being completed even if they will be conducted during off hours (nights, weekends, and state holidays). Abatement is defined as an activity specifically designed to permanently remove lead paint, lead-contaminated dust or other lead containing materials, the installation of a permanent enclosure or encapsulation of lead paint or other lead containing materials, the replacement of lead-painted surfaces or fixtures, the removal or covering of lead-contaminated soil, and any preparation, cleanup, disposal, and post-abatement clearance testing associated with these activities. Renovation, remodeling, landscaping, or other activity, that is not designed to permanently eliminate lead paint hazards, but is instead designed to repair, restore, or remodel a structure, or housing unit even though the activity may incidentally result in a reduction or elimination of a lead paint hazard is not considered abatement.

If abatement of lead or materials containing lead is required, abatement must be completed by a qualified Lead Abatement Contractor. In addition, Specifications for the Lead Abatement should be based upon a Lead Inspection/Risk Assessment report. The Lead Inspection/Risk Assessment report and clearance testing upon completion should be performed by a Certified Inspector or Risk Assessor. Lead abatement including clearance testing shall be performed in accordance with the State of Michigan, Lead Abatement Act, Part 54A Lead Abatement and with all other federal, state, and local Laws and Regulations that may apply

For additional information about certifications, guidance, and regulations for lead hazard control activities, visit www.michigan.gov/lead.



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DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
State Facilities Administration
Design & Construction Division

APPENDIX III

STATE OF MICHIGIAN PREVAILING WAGE SCHEDULES

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
3.1 Power Equip. Operator - Highway & Heavy	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$71.46	\$94.57	\$117.67
Apprentice: Level 1 0 - 6 Months	\$57.61	\$73.79	\$89.97
Apprentice: Level 2 7 -12 Months	\$59.93	\$77.28	\$94.61
Apprentice: Level 3 13 - 18 Months	\$62.23	\$80.73	\$99.21
Apprentice: Level 4 19 - 24 Months	\$64.54	\$84.19	\$103.83
Apprentice: Level 5 25 - 30 Months	\$66.85	\$87.66	\$108.45
Apprentice: Level 6 31 - 36 Months	\$69.15	\$91.10	\$113.05

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
3.2 Power Equip. Operator - Highway & Heavy	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$70.31	\$92.84	\$115.37
Apprentice: Level 1 0 - 6 Months	\$56.81	\$72.59	\$88.37
Apprentice: Level 2 7 -12 Months	\$59.06	\$75.97	\$92.87
Apprentice: Level 3 13 - 18 Months	\$61.31	\$79.35	\$97.37
Apprentice: Level 4 19 - 24 Months	\$63.56	\$82.72	\$101.87
Apprentice: Level 5 25 - 30 Months	\$65.81	\$86.09	\$106.37
Apprentice: Level 6 31 - 36 Months	\$68.06	\$89.47	\$110.87

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
3.3 Power Equip. Operator - Highway & Heavy	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.58	\$82.75	\$101.91
Apprentice: Level 1 0 - 6 Months	\$52.10	\$65.53	\$78.95
Apprentice: Level 2 7 -12 Months	\$54.02	\$68.41	\$82.79
Apprentice: Level 3 13 - 18 Months	\$55.92	\$71.26	\$86.59
Apprentice: Level 4 19 - 24 Months	\$57.84	\$74.14	\$90.43
Apprentice: Level 5 25 - 30 Months	\$59.75	\$77.00	\$94.25
Apprentice: Level 6 31 - 36 Months	\$61.67	\$79.89	\$98.09

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
3.4 Power Equip. Operator - Highway & Heavy	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.02	\$81.91	\$100.79
Apprentice: Level 1 0 - 6 Months	\$51.70	\$64.93	\$78.15
Apprentice: Level 2 7 -12 Months	\$53.59	\$67.76	\$81.93
Apprentice: Level 3 13 - 18 Months	\$55.48	\$70.60	\$85.71
Apprentice: Level 4	\$57.36	\$73.42	\$89.47
Apprentice: Level 5 25 - 30 Months	\$59.25	\$76.25	\$93.25
Apprentice: Level 6 31 - 36 Months	\$61.13	\$79.07	\$97.01

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
3.5 Power Equip. Operator - Highway & Heavy	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$44.80	\$60.98	\$77.15
Apprentice: Level 1 0 - 6 Months	\$35.09	\$46.42	\$57.73
Apprentice: Level 2 7 -12 Months	\$36.71	\$48.84	\$60.97
Apprentice: Level 3 13 - 18 Months	\$38.33	\$51.27	\$64.21
Apprentice: Level 4 19 - 24 Months	\$39.95	\$53.71	\$67.45
Apprentice: Level 5 25 - 30 Months	\$41.57	\$56.13	\$70.69
Apprentice: Level 6 31 - 36 Months	\$43.18	\$58.55	\$73.91

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.1 Power Equip. Operator - Commercial	10/31/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$71.22	\$94.21	\$117.19
Apprentice: Level 1 0 - 6 Months	\$57.43	\$73.52	\$89.61
Apprentice: Level 2 7 - 12 Months	\$59.73	\$76.97	\$94.21
Apprentice: Level 3 13 - 18 Months	\$62.03	\$80.42	\$98.81
Apprentice: Level 4 19 - 24 Months	\$64.32	\$83.86	\$103.39
Apprentice: Level 5 25 - 30 Months	\$66.62	\$87.31	\$107.99
Apprentice: Level 6 31 - 36 Months	\$68.92	\$90.76	\$112.59

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.2 Power Equip. Operator - Commercial	10/31/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$70.93	\$93.77	\$116.61
Apprentice: Level 1 0 - 6 Months	\$57.22	\$73.21	\$89.19
Apprentice: Level 2 7 - 12 Months	\$59.51	\$76.65	\$93.77
Apprentice: Level 3 13 - 18 Months	\$61.80	\$71.52	\$89.80
Apprentice: Level 4 19 - 24 Months	\$64.07	\$83.48	\$102.89
Apprentice: Level 5 25 - 30 Months	\$66.36	\$86.92	\$107.47
Apprentice: Level 6 31 - 36 Months	\$68.64	\$90.33	\$112.03

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.3 Power Equip. Operator - Commercial	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$70.11	\$92.55	\$114.97
Apprentice: Level 1 0 - 6 Months	\$56.66	\$72.37	\$88.07
Apprentice: Level 2 7 - 12 Months	\$58.90	\$75.73	\$92.55
Apprentice: Level 3 13 - 18 Months	\$61.14	\$79.09	\$97.03
Apprentice: Level 4 19 - 24 Months	\$63.38	\$82.45	\$101.51
Apprentice: Level 5 25 -30 Months	\$65.63	\$85.82	\$106.01
Apprentice: Level 6 31 - 36 Months	\$67.87	\$89.18	\$110.49

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.4 Power Equip. Operator - Commercial	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$69.25	\$91.25	\$113.25
Apprentice: Level 1 0 - 6 Months	\$56.05	\$71.45	\$86.85
Apprentice: Level 2 7 - 12 Months	\$58.25	\$74.75	\$91.25
Apprentice: Level 3 13 -18 Months	\$60.45	\$78.06	\$95.65
Apprentice: Level 4 19 - 24 Months	\$62.65	\$81.35	\$100.05
Apprentice: Level 5 25 - 30 Months	\$64.85	\$84.66	\$104.45
Apprentice: Level 6 31 -36 Months	\$67.05	\$87.96	\$108.85

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.5 Power Equip. Operator - Commercial	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$68.28	\$89.80	\$111.31
Apprentice: Level 1 0 - 6 Months	\$55.37	\$70.44	\$85.49
Apprentice: Level 2 7 -12 Months	\$57.53	\$73.68	\$89.81
Apprentice: Level 3 13 - 18 Months	\$61.83	\$80.12	\$98.41
Apprentice: Level 5 25 - 30 Months	\$63.98	\$83.35	\$102.71
Apprentice: Level 6 31 - 36 Months	\$66.13	\$86.58	\$107.01

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.6 Power Equip. Operator - Commercial	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$66.57	\$87.24	\$107.89
Apprentice: Level 1 0 - 6 Months	\$54.17	\$68.64	\$83.09
Apprentice: Level 2 7 -12 Months	\$56.24	\$71.74	\$87.23
Apprentice: Level 3 13 - 18 Months	\$58.30	\$74.82	\$91.35
Apprentice: Level 4 19 -24 Months	\$60.37	\$77.93	\$95.49
Apprentice: Level 5 25 - 30 Months	\$62.44	\$81.04	\$99.63
Apprentice: Level 6 31 - 36 Months	\$64.50	\$84.13	\$103.75

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.7 Power Equip. Operator - Commercial	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$59.26	\$67.72	\$84.72
Apprentice: Level	\$54.15	\$68.61	\$83.05
Apprentice: Level 1 0 - 6 Months	\$49.05	\$60.95	\$72.85
Apprentice: Level 2 7 -12 Months	\$50.76	\$63.52	\$76.27
Apprentice: Level 3 13 - 18 Months	\$52.46	\$66.07	\$79.67
Apprentice: Level 5 25 - 30 Months	\$55.85	\$71.16	\$86.45
Apprentice: Level 6 31 - 36 Months	\$57.55	\$73.71	\$89.85

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
4.8 Power Equip. Operator - Commercial	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$58.23	\$74.72	\$91.21
Apprentice: Level 1 0 - 6 Months	\$48.34	\$59.88	\$71.43
Apprentice: Level 2 7 -12 Months	\$49.99	\$62.37	\$74.73
Apprentice: Level 3 13 - 18 Months	\$51.63	\$64.82	\$78.01
Apprentice: Level 4 19 - 24 Months	\$53.29	\$67.31	\$81.33
Apprentice: Level 5 25 - 30 Months	\$54.93	\$69.78	\$84.61
Apprentice: Level 6 25 - 30 Months	\$56.59	\$72.27	\$87.93

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
5.1 Truck Driver Class	01/05/2026		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$54.10	\$70.52	\$86.94

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Articulated Hauler	10/28/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.02	\$81.91	\$100.79
Apprentice: Apprentice Level 1	\$51.70	\$64.93	\$78.15
Apprentice: Apprentice Level 2	\$53.59	\$67.76	\$81.93
Apprentice: Apprentice Level 3	\$55.48	\$70.60	\$85.71
Apprentice: Apprentice Level 4	\$57.36	\$73.42	\$89.47
Apprentice: Apprentice Level 5	\$59.25	\$76.25	\$93.25
Apprentice: Apprentice Level 6	\$61.13	\$79.07	\$97.01

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Asbestos abatement worker or environmental remediation worker	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$56.20	\$73.24	\$90.28
Apprentice: Trainee 600 hours + 1 year	\$43.12	\$55.01	\$66.90

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Boilermaker	10/29/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$79.64	\$119.12	\$158.58
Apprentice: 1st Period	\$58.07	\$86.78	\$115.44
Apprentice: 2nd Period	\$59.89	\$89.50	\$119.08
Apprentice: 3rd Period	\$61.81	\$92.24	\$122.74
Apprentice: 4th Period	\$63.50	\$94.91	\$126.30
Apprentice: 5th Period	\$65.26	\$97.54	\$129.82
Apprentice: 6th Period	\$68.89	\$103.00	\$137.08
Apprentice: 7th Period	\$72.46	\$108.36	\$144.22
Apprentice: 8th Period	\$76.07	\$113.77	\$151.44

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Boom Truck	10/28/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$70.31	\$92.84	\$115.37
Apprentice: Apprentice Level 1	\$56.81	\$72.59	\$88.37
Apprentice: Apprentice Level 2	\$59.06	\$75.97	\$92.87
Apprentice: Apprentice Level 3	\$61.31	\$79.35	\$97.37
Apprentice: Apprentice Level 4	\$63.56	\$82.72	\$101.87

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Bricklayer	10/29/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$58.37	\$74.52	\$90.67
Apprentice: Apprentice Level 1	\$40.55	\$50.76	\$60.97
Apprentice: Apprentice Level 2	\$42.37	\$53.49	\$64.61
Apprentice: Apprentice Level 3	\$44.18	\$56.21	\$68.23
Apprentice: Apprentice Level 4	\$45.99	\$58.92	\$71.85
Apprentice: Apprentice Level 5	\$47.80	\$61.64	\$75.47
Apprentice: Apprentice Level 6	\$49.61	\$64.35	\$79.09
Apprentice: Apprentice Level 7 & 8	\$51.43	\$67.08	\$82.73

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Carpenter	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$54.28	\$71.29	\$88.29
Apprentice: Apprentice Level 1	\$47.43	\$59.34	\$71.24
Apprentice: Apprentice Level 2	\$48.28	\$60.61	\$72.94
Apprentice: Apprentice Level 3	\$49.13	\$61.89	\$74.64
Apprentice: Apprentice Level 4	\$50.83	\$64.44	\$78.04
Apprentice: Apprentice Level 5	\$52.53	\$66.99	\$81.44
Apprentice: Apprentice Level 6	\$54.23	\$69.54	\$84.84
Apprentice: Apprentice Level 7	\$55.93	\$72.09	\$88.24
Apprentice: Apprentice Level 8	\$56.78	\$73.36	\$89.94

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Friday make up day for 4-10s

Saturday make up day for 5-8s for inclement weather

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Carpet layers (linoleum)	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$53.72	\$70.77	\$87.81
Apprentice: Level 1	\$43.49	\$55.42	\$67.35
Apprentice: Level 2	\$45.20	\$57.99	\$70.77
Apprentice: Level 3	\$48.61	\$63.10	\$77.59
Apprentice: Level 4	\$52.02	\$68.22	\$84.41

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Cement Mason	10/29/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$54.48	\$69.47	\$84.45
Apprentice: Apprentice Level 1	\$41.60	\$52.65	\$63.69
Apprentice: Apprentice Level 2	\$43.32	\$55.23	\$67.13
Apprentice: Apprentice Level 3	\$45.03	\$57.79	\$70.55
Apprentice: Apprentice Level 4	\$46.74	\$60.36	\$73.97
Apprentice: Apprentice Level 5 & 6	\$48.45	\$62.92	\$77.39

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Drywall taper	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$52.69	\$67.80	\$82.91
Apprentice: Level 1	\$42.11	\$51.93	\$61.75
Apprentice: Level 2	\$45.13	\$56.46	\$67.79
Apprentice: Level 3	\$49.67	\$63.27	\$76.87

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Electrician	10/29/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.34	\$89.93	\$116.50
Apprentice: Apprentice Level 1	\$25.15	\$34.59	\$44.02
Apprentice: Apprentice Level 2	\$27.24	\$37.72	\$48.20
Apprentice: Apprentice Level 3	\$29.33	\$40.55	\$51.76
Apprentice: Apprentice Level 4	\$33.89	\$47.71	\$61.50
Apprentice: Apprentice Level 5	\$36.18	\$51.14	\$66.08
Apprentice: Apprentice Level 6	\$43.08	\$61.49	\$79.88

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Additional Jurisdiction Detail: Lovells Township ONLY.

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Electrician	10/31/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$62.67	\$89.19	\$115.69
Apprentice: 1st & 2nd Period Apprentice	\$27.39	\$36.72	\$46.03
Apprentice: 3rd Period Apprentice	\$32.03	\$43.69	\$55.31
Apprentice: 4th Period Apprentice	\$34.16	\$46.88	\$59.57
Apprentice: 5th Period Apprentice	\$39.29	\$54.57	\$69.83
Apprentice: 6th Period Apprentice	\$43.65	\$61.10	\$78.55

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - No

Additional Jurisdiction Detail: All Townships EXCEPT Lovells.

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Elevator Constructors	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$98.25	\$130.76	\$163.26
Apprentice: 1st Year Apprentice	\$63.80	\$81.68	\$99.56
Apprentice: 2nd Year Apprentice	\$72.84	\$93.97	\$115.10
Apprentice: 3rd Year Apprentice	\$76.28	\$99.04	\$121.79
Apprentice: 4th Year Apprentice	\$83.17	\$109.18	\$135.18

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Glaziers	10/31/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$47.60	\$62.95	\$78.30
Apprentice: Level 1	\$35.32	\$44.53	\$53.74
Apprentice: Level 2	\$38.39	\$49.14	\$59.88
Apprentice: Level 3	\$41.46	\$53.74	\$66.02
Apprentice: Level 4	\$44.52	\$58.33	\$72.14

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Ground Person	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$50.85	\$72.32	\$93.78

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Heating and frost Insulators	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.85	\$83.85	\$103.85
Apprentice: 1st period	\$44.28	\$56.28	\$68.28
Apprentice: 2nd period	\$49.17	\$63.17	\$77.17
Apprentice: 3rd period	\$54.06	\$70.06	\$86.06
Apprentice: 4th period	\$58.96	\$76.96	\$94.96

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Friday for cancelled work in a 4 10 schedule

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Ironworker	10/31/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$75.42	\$93.70	\$111.97
Apprentice: Apprentice Level 1	\$57.42	\$70.40	\$83.37
Apprentice: Apprentice Level 2	\$59.59	\$73.12	\$86.64
Apprentice: Apprentice Level 3	\$61.54	\$75.43	\$89.32
Apprentice: Apprentice Level 4	\$64.59	\$79.40	\$94.20
Apprentice: Apprentice Level 5	\$67.64	\$83.36	\$99.07
Apprentice: Apprentice Level 6	\$75.42	\$93.70	\$111.97

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Laborer, Common - Commercial	11/04/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$38.88	\$51.39	\$63.90
Apprentice: Level 1 0-1000	\$32.63	\$42.02	\$51.40
Apprentice: Level 2 1001-2000 Hours	\$33.88	\$43.89	\$53.90
Apprentice: Level 3 2001-3000 hours	\$35.13	\$45.77	\$56.40
Apprentice: Level 4 3001-4000 Hours	\$37.63	\$49.52	\$61.40

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Laborer, Common - Highway & Heavy	11/05/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$47.52	\$61.33	\$75.14
Apprentice: Apprentice Level 1	\$40.61	\$50.97	\$61.32
Apprentice: Apprentice Level 2	\$42.00	\$53.05	\$64.10
Apprentice: Apprentice Level 3	\$43.38	\$55.12	\$66.86
Apprentice: Apprentice Level 4	\$46.14	\$59.26	\$72.38

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Laborer, Landscaping	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$36.87	\$49.23	\$61.58
Apprentice: Apprentice Level 1	\$30.69	\$39.96	\$49.22
Apprentice: Apprentice Level 2	\$31.93	\$41.82	\$51.70
Apprentice: Apprentice Level 3	\$33.16	\$43.66	\$54.16
Apprentice: Apprentice Level 4	\$35.63	\$47.37	\$59.10

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Laborer, Skilled - Commercial	11/04/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$40.23	\$53.35	\$66.46

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Laborer, Skilled - Highway & Heavy	11/05/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$48.51	\$62.82	\$77.12
Apprentice: Level 1	\$41.36	\$52.09	\$62.82
Apprentice: Level 2	\$42.79	\$54.24	\$65.68
Apprentice: Level 3	\$44.22	\$56.38	\$68.54
Apprentice: Level 4	\$47.08	\$60.67	\$74.26

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Landscaping equipment	10/28/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$39.09	\$52.56	\$66.02

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Lineman	10/30/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$76.81	\$111.26	\$145.70
Apprentice: Level 1 0-1000 hours	\$49.26	\$69.94	\$90.60
Apprentice: Level 2 1001-2000 Hours	\$52.71	\$75.11	\$97.50
Apprentice: Level 3 2001-3000 Hours	\$56.15	\$80.28	\$104.38
Apprentice: Level 4 3001-4000 hours	\$59.60	\$85.44	\$111.28
Apprentice: Level 5 4001-5000 Hours	\$63.04	\$90.60	\$118.16
Apprentice: Level 6 5001-6000 Hours	\$66.48	\$95.77	\$125.04
Apprentice: Level 7	\$69.93	\$100.94	\$131.94

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Low Voltage Technician	01/27/2026		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$44.28	\$61.96	\$79.63
Apprentice: Level 1	\$23.10	\$32.44	\$41.77
Apprentice: Level 2	\$26.47	\$37.49	\$48.51
Apprentice: Level 3	\$29.87	\$42.60	\$55.31
Apprentice: Level 4	\$33.26	\$47.68	\$62.09

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Additional Jurisdiction Detail: Lovells Township ONLY.

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Millwright	11/05/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$67.21	\$89.35	\$111.46
Apprentice: Level 1	\$53.94	\$69.44	\$84.92
Apprentice: Level 2	\$58.36	\$76.07	\$93.76
Apprentice: Level 3	\$62.79	\$82.71	\$102.62

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Off-Road Truck	10/29/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.02	\$81.91	\$100.79
Apprentice: Apprentice Level 1	\$51.70	\$64.93	\$78.15
Apprentice: Apprentice Level 2	\$53.59	\$67.76	\$81.93
Apprentice: Apprentice Level 3	\$55.48	\$70.60	\$85.71
Apprentice: Apprentice Level 4	\$57.36	\$73.42	\$89.47
Apprentice: Apprentice Level 5	\$59.25	\$76.25	\$93.25
Apprentice: Apprentice Level 6	\$61.13	\$79.07	\$97.01

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Painters	10/30/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$48.48	\$63.10	\$77.71
Apprentice: Apprentice Level 1	\$36.79	\$45.56	\$54.33
Apprentice: Apprentice Level 2	\$39.71	\$49.94	\$60.17
Apprentice: Apprentice Level 3	\$42.63	\$54.32	\$66.01
Apprentice: Apprentice Level 4	\$45.56	\$58.72	\$71.87

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Piledriver	11/01/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$52.57	\$68.24	\$83.90
Apprentice: Apprentice Level 1	\$43.17	\$54.14	\$65.10
Apprentice: Apprentice Level 2	\$44.74	\$56.49	\$68.24
Apprentice: Apprentice Level 3	\$47.87	\$61.19	\$74.50
Apprentice: Apprentice Level 4	\$51.00	\$65.88	\$80.76

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Pipefitters—Steamfitters	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.84	\$84.35	\$104.85
Apprentice: Level 1	\$38.70	\$48.95	\$59.20
Apprentice: Level 2	\$41.30	\$52.58	\$63.86
Apprentice: Level 3	\$43.90	\$56.21	\$68.51
Apprentice: Level 4	\$46.50	\$59.83	\$73.16
Apprentice: Level 5	\$49.10	\$63.46	\$77.81
Apprentice: Level 6	\$51.70	\$67.08	\$82.46
Apprentice: Level 7	\$54.30	\$70.71	\$87.11
Apprentice: Level 8	\$56.90	\$74.33	\$91.76
Apprentice: Level 9	\$59.50	\$77.95	\$96.41

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Plumbers	10/29/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$63.84	\$84.35	\$104.85
Apprentice: Level 1	\$38.70	\$48.95	\$59.20
Apprentice: Level 2	\$41.30	\$52.58	\$63.86
Apprentice: Level 3	\$43.90	\$56.21	\$68.51
Apprentice: Level 4	\$46.50	\$59.83	\$73.16
Apprentice: Level 5	\$49.10	\$63.46	\$77.81
Apprentice: Level 6	\$51.70	\$67.08	\$82.46
Apprentice: Level 7	\$54.30	\$70.71	\$87.11
Apprentice: Level 8	\$56.90	\$74.33	\$91.76
Apprentice: Level 9	\$59.50	\$77.95	\$96.41

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Roofer/waterproofer	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$41.35	\$53.75	\$66.15
Apprentice: Apprentice 1	\$31.62	\$39.59	\$47.56
Apprentice: Apprentice 2	\$33.03	\$41.66	\$50.29
Apprentice: Apprentice 3	\$34.39	\$43.66	\$52.92
Apprentice: Apprentice 4	\$35.76	\$45.67	\$55.58
Apprentice: Apprentice 5	\$37.12	\$47.67	\$58.21
Apprentice: Apprentice 6	\$37.92	\$48.82	\$59.72

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Sheet Metal Workers	10/31/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$67.48	\$86.53	\$105.58
Apprentice: Level 1	\$36.88	\$48.31	\$59.74
Apprentice: Level 2	\$38.98	\$51.37	\$63.75
Apprentice: Level 3	\$45.95	\$59.29	\$72.62
Apprentice: Level 4	\$50.14	\$65.38	\$80.62

Four 10-hour days allowed? - No

Make Up Day Allowed? - No

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Sprinkler Fitters	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$60.34	\$78.45	\$96.56
Apprentice: Class 1	\$24.57	\$32.72	\$40.87
Apprentice: Class 10	\$52.07	\$68.37	\$84.67
Apprentice: Class 2	\$26.38	\$35.43	\$44.49
Apprentice: Class 3	\$39.14	\$49.10	\$59.06
Apprentice: Class 4	\$40.95	\$51.82	\$62.68
Apprentice: Class 5	\$43.01	\$54.78	\$66.55
Apprentice: Class 6	\$44.82	\$57.49	\$70.17
Apprentice: Class 7	\$46.63	\$60.21	\$73.79
Apprentice: Class 8	\$48.45	\$62.94	\$77.43
Apprentice: Class 9	\$50.26	\$65.65	\$81.05

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Terrazzo Workers	04/17/2026		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$56.86	\$72.84	\$88.81
Apprentice: Level 1	\$43.04	\$53.11	\$63.17
Apprentice: Level 2	\$44.96	\$55.99	\$67.01
Apprentice: Level 3	\$46.55	\$58.37	\$70.19
Apprentice: Level 4	\$48.47	\$61.25	\$74.03
Apprentice: Level 5	\$51.98	\$66.52	\$81.05
Apprentice: Level 6 and 7	\$53.90	\$69.40	\$84.89

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Tile Finishers			
04/17/2026			
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$49.30	\$62.80	\$76.30
Apprentice: Level 1	\$40.55	\$50.68	\$60.80
Apprentice: Level 2	\$42.17	\$53.11	\$64.04
Apprentice: Level 3	\$43.79	\$55.53	\$67.28
Apprentice: Level 4	\$45.14	\$57.56	\$69.98
Apprentice: Level 5	\$46.76	\$59.99	\$73.22

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Tile Setters	04/17/2026		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$56.36	\$72.09	\$87.81
Apprentice: Level 1	\$42.72	\$52.63	\$62.53
Apprentice: Level 2	\$44.61	\$55.46	\$66.31
Apprentice: Level 4	\$46.18	\$57.82	\$69.45
Apprentice: Level 5	\$48.07	\$60.65	\$73.23
Apprentice: Level 6	\$51.53	\$65.84	\$80.15
Apprentice: Level 7 and 8	\$53.42	\$68.68	\$83.93

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Tunnel Miner	11/03/2025		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$52.82	\$70.02	\$87.22
Apprentice: Level 1	\$44.22	\$57.12	\$70.02
Apprentice: Level 2	\$45.94	\$59.70	\$73.46
Apprentice: Level 3	\$47.66	\$62.28	\$76.90
Apprentice: Level 4	\$51.10	\$61.35	\$75.66

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes

Prevailing Wage Rates for State Of Michigan Funded Projects

Official Rate Schedule

Crawford

Classification Name	Last Updated		
Underground and Open Cut Laborer	01/06/2026		
Wage Rates	Straight Time	Time and a Half	Double Time
Journeyman	\$47.67	\$62.03	\$76.39
Apprentice: Level 1	\$40.49	\$51.26	\$62.03
Apprentice: Level 2	\$41.93	\$53.42	\$64.91
Apprentice: Level 3	\$43.36	\$55.57	\$67.77
Apprentice: Level 4	\$46.23	\$59.87	\$73.51

Four 10-hour days allowed? - Yes

Make Up Day Allowed? - Yes



R 03/21

DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
State Facilities Administration
Design & Construction Division

APPENDIX IV

TECHNICAL SPECIFICATIONS

DESCRIPTION

The Badger Meter ModMAG[®] M2000 is the result of years of research and field use of electromagnetic flow meter technology. Based on Faraday's law of induction, these meters can measure water, wastewater, water-based fluids and other liquids that meet minimum electrical conductivity.

Designed, developed and manufactured under strict quality standards, this meter features sophisticated, processor-based signal conversion with accuracies of $\pm 0.20\%$ of rate ± 1 mm/s. The wide selection of liner and electrode materials helps provide maximum compatibility and minimum maintenance over a long operating period.

The meter is best suited for bidirectional flow measurement of fluids with a conductivity $> 5 \mu\text{S}/\text{cm}$ ($> 20 \mu\text{S}/\text{cm}$ for demineralized water). The meter has high accuracy, is easy to use and can be chosen for a wide variety of applications. The backlit, four-line display shows all actual flow measuring data, daily and complete information, including alarm messages. The standard transmitter has 4 programmable digital outputs, one digital input, power output and different interfaces. Integrated system self checkup makes putting into operation and service easier. For service purpose, the meter configuration can be kept or transferred to another meter without a new parametering via the optional back-up parameter function.

APPLICATION

The M2000 transmitter can be integrally mounted to the sensor or can be remote-mounted, if necessary and has many advantages over other conventional technologies. The meter targets a variety of applications and is well suited for the diverse water and wastewater treatment industry. The M2000 meter can accurately measure fluid flow—whether the fluid is water or a highly corrosive liquid, very viscous, contains a moderate amount of solids, or requires special handling. Today, electromagnetic meters are successfully used in industries including building automation, oil and gas, food and beverage, pharmaceutical, water and wastewater, and chemical.

STRAIGHT PIPE REQUIREMENTS

Run sufficient straight-pipe at the sensor inlet and outlet for optimum meter accuracy and performance. An equivalent of 3–7 diameters of straight pipe is required on the inlet (upstream) side to provide a stable flow profile. Two (2) diameters are required on the outlet (downstream) side.

In applications with limited space, the M2000 can be installed with zero straight pipe requirements and fulfils the accuracy according OIML R49 and MID Annex MI-001.



FEATURES

- Available in sizes 0.25–78 in. (6–2000 mm)
- Accuracy of $\pm 0.2\%$ of reading ± 1 mm/s
- Flow Range 0.03–12 m/s
- Pulsed DC magnetic field for zero point stability
- Integral and remote signal converter availability
- Power Supply of 100–240V AC / 12–32V DC
- Corrosion-resistant liners for long life
- Zero Straight Run (0 x DN) OIML/MID
- User friendly programming procedure
- Empty pipe detection
- Power loss totalization
- Digital signal processor (32-bit)
- Non-volatile programming memory
- LCD display
- Rotating cover
- IP67 Housing
- Calibrated in state-of-the-art facilities
- Modbus[®] RTU or Modbus TCP/IP, HART, M-Bus, EtherNet/IP, BACnet/IP, BACnet MS/TP (BTL certification), Profibus DP
- Integrated data logger
- Verifications device
- NSF/ANSI/CAN 61 and 372 listed
- CSA / AWWA C715 certified
- BEACON[®]/AquaCUE[®] connectivity

ELECTRODES

When looking from the end of the meter into the inside bore, the two measuring electrodes are positioned at three o'clock and nine o'clock. M2000 electromagnetic meters have an "empty pipe detection" feature. This is accomplished with a third electrode positioned in the meter at twelve o'clock.

If this electrode is not covered by fluid for a minimum five-second duration, the meter displays an "empty pipe detection" condition, sends out an error message, if desired, and stops measuring to maintain accuracy. When the electrode again becomes covered with fluid, the error message disappears and the meter resumes measuring.

As an option to using grounding rings, a grounding electrode (fourth electrode) can be built into the meter during manufacturing to assure proper grounding. The position of this electrode is at six o'clock.

OPERATION

The flow meter is a stainless steel tube lined with a non-conductive material. Outside the tube, two DC powered electromagnetic coils are positioned opposing each other. Perpendicular to these coils, two electrodes are inserted into the flow tube. Energized coils create a magnetic field across the whole diameter of the pipe.

As a conductive fluid flows through the magnetic field, a voltage is induced across the electrodes. This voltage is proportional to the average flow velocity of the fluid and is measured by the two electrodes. The M2000 transmitter receives the sensor's analog signal, amplifies that signal and converts it into digital information. At the processor level, the signal is analyzed through a series of sophisticated software algorithms. After separating the signal from electrical noise, it is converted into both analog and digital signals that are used to display rate of flow and totalization.

With no moving parts in the flow stream, there is no pressure lost. Also, accuracy is not affected by temperature, pressure, viscosity or density and there is practically no maintenance required.

SPECIFICATIONS

NOTE: Permanently connected equipment requires the special considerations to satisfy the CEC and the Canadian deviations in the standard, including overcurrent and fault protection as required.

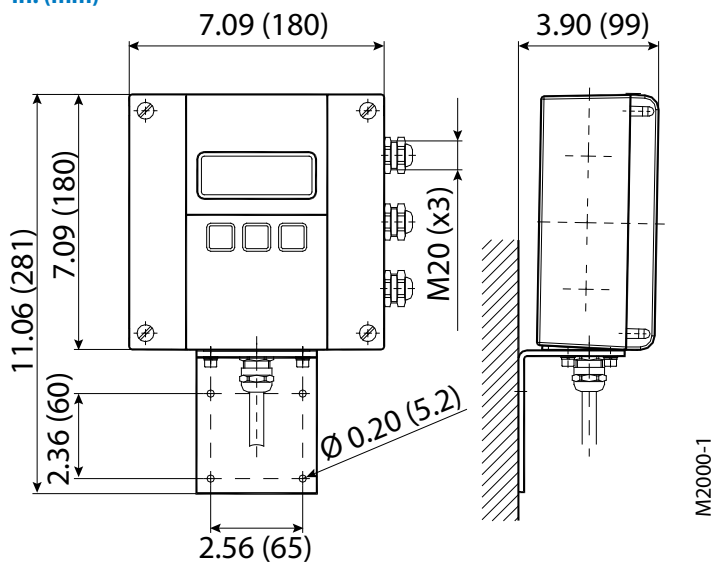
NOTE: DN represents nominal diameter in mm.

Transmitter Specifications

Flow Range	0.10–39.4 ft/s (0.03...12 m/s)
Accuracy	± 0.20% m.v. ± 1 mm/s OIML/MID: 2–32 in. (DN50–800) with 0d up and 0d downstream ±1% ≥ 0.5 ft/s (0.15 m/s)
Repeatability	± 0.1%
Power Supply	AC Power Supply: 100–240V AC (±10%); Typical Power: 20W A or 15W; Maximum Power: 26V A or 20W Optional DC Power Supply: 12–32V DC (±10%); Typical Power: 10W; Maximum Power: 14W
Analog Output	4–20 mA, 0–20 mA, 0–10 mA, 2–10 mA (programmable and scalable) Voltage sourced 24V DC isolated. Maximum loop resistance < 800 Ohms.
Digital Output	Four total, configurable 24V DC sourcing active output (up to 2), 100 mA total, 50 mA each; sinking open collector output (up to four), 30V DC max, 100 mA each; solid-state relay (up to 2), 48V DC, 500 mA max, either polarity Absolute Digital Encoded output for connectivity to AquaCUE or BEACON cellular endpoints
Digital Input	Max 30V DC (programmable – positive zero return, external totalizer reset or preset batch start)
Frequency Output	Scalable up to 10 kHz, open collector up to 1 kHz, solid-state relay
Misc Output	High/low flow alarm (0–100% of flow), error alarm, empty pipe alarm, flow direction, preset batch alarm, 24V DC supply, ADE
Communication	RS232 Modbus RTU; RS485 Modbus RTU, HART, Profibus DP, BACnet MS/TP, Modbus TCP/IP, EtherNet/IP and BACnet/IP require separate daughterboards
Pulse Width	Scalable up to 10 kHz, passive open collector up to 10 kHz, active switched 24V DC. Up to two outputs (forward and reverse). Pulse width programmable from 1–1000 ms or 50% duty cycle.
Processing	32-bit DSP
Empty Pipe Detection	Field tunable for optimum performance based on specific application
Excitation Frequency	1 Hz, 3.75 Hz, 7.5 Hz or 15 Hz (factory optimized to pipe diameter)
Noise Dampening	Programmable 0–30 seconds
Low Flow Cut-Off	Programmable 0–10% of maximum flow
Galvanic Separation	250V
Fluid Conductivity	Minimum 5.0 µS/cm (minimum 20 µS/cm for demineralized water)
Fluid Temperature	With Remote Transmitter: PFA, PTFE & ETFE 302° F (150° C) With Meter-Mounted Transmitter: Rubber 178 °F, (80 °C), PFA, PTFE & ETFE 212 °F (100 °C)
Ambient Temperature	– 4 to 140 °F (–20 to 60 °C)
Relative Humidity	Up to 90 percent non-condensing

Pollution Degree	2		
Installation Category	II		
Altitude	8202 ft (2500 m)		
Flow Direction	Unidirectional or bidirectional two separate totalizers (programmable)		
Totalization	Programmable/resettable		
Units of Measure	Ounce, pound, liter, US gallon, imperial gallon, barrel, hectoliter, mega gallon, cubic meter, cubic feet, acre feet		
Display	4 x 20 character display with backlight		
Programming	Three-button, external manual or remote		
Transmitter Housing	Cast aluminum, powder-coated paint		
Mounting	Meter mount or remote wall mount (bracket supplied)		
Locations	Indoor and outdoor		
Meter Enclosure Classification	Standard: NEMA 4X (IP67); Optional: Submersible NEMA 6P (IP68) depth of 2 m for 72 hr, remote transmitter required		
Junction Box Enclosure Protection	For remote transmitter option: powder-coated die-cast aluminum, NEMA 4 (IP67)		
Cable Entries	M20 cable glands (3)		
Optional Stainless Steel Grounding Rings	Meter Size	Thickness of one ring	Thickness of one ring (DIN Flanges)
	Up through 10 in.	0.135 in. (3.429 mm)	0.12 in. (3 mm)
	12–78 in.	0.187 in. (4.750 mm)	0.12 in. (3 mm)
NSF/ANSI/CAN 61 and 372 Listed	NSF-61 hard rubber and PTFE liner, all sizes		
WRAS, ACS, KTW	WRAS (hard rubber), ACS (PTFE), KTW (PTFE)		
OIML R49-1	Size range: DN50–800 / 2–28 in.		
MID MI-001	Minimum straight inlet flow: 0 DN /outlet flow: 0 DN		
AWWA C715	Forward and reverse (bi-directional) flow on any orientation		
MCERT	Ratio (Q3/Q1) up to 250		
	Accuracy Class 1 and Class 2		
Token Features	Data Logging (Blue token); Store/Restore (Red token); Firmware Upgrade (Black token)		

M2000 Transmitter Dimensions
in. (mm)



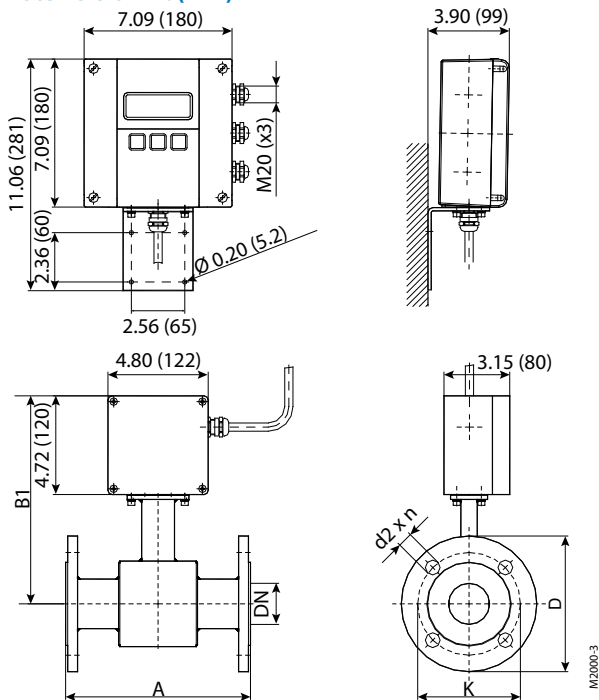
Sensor Type II Specifications

The electromagnetic sensor type II is not only available in a number of different flange process connections (DIN, ANSI, JIS, AWWA) but also in a number of liners like hard rubber, PTFE, PFA or ETFE. The sensor is configurable with up to 4 electrodes for measuring, empty pipe and grounding electrodes. Available in sizes from DN 6 TO DN 2000 and nominal pressures up to PN 100, the sensor type II is best suited for a variety of applications in the industry and the water/waste water industry.

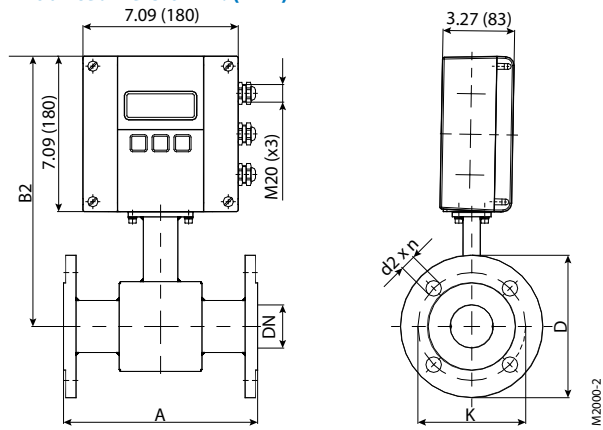
Size	1/4–78 in. (DN 6–2000)	
Flanges	Standard: ANSI B16.5, AWWA, ISO 1092-1, JIS and more in carbon steel; Optional: 304 or 316 stainless steel	
Nominal Pressure	Up to 1450 psi (100 bar)	
Pressure Rating	Line sizes 1/4–24 in: In accordance with ASME B16.5 Class 150 or Flange Rating Class 300 Line sizes 26–78 in: AWWA C-207 Class D or Class E Flange Rating	
Protection Class	NEMA 4X (IP67), optional NEMA 6P (IP68)	
Minimum Conductivity	5 μ S/cm (20 μ S/cm for demineralized water)	
Liner Material	Hard rubber	1–78 in. (DN 25–2000) 32–176 °F (0–80 °C)
	PTFE	1/2–24 in. (DN 15–600) –40 to 302 °F (–40 to 150 °C)
	ETFE	12 in. (DN 300) and larger –40 to 302 °F (–40 to 150 °C)
	PFA	1/4–3/8 in. (DN 6–10) —
Measuring tube	Stainless steel, lined by different materials	
Housing	Standard: Carbon steel welded; Optional: 316 or 304 stainless steel	
Electrode Materials	Standard: Hastelloy C22; Optional: 316 stainless steel, gold/platinum plated, tantalum, platinum/rhodium	
Lay Length	See "A Standard" and "A ISO" in the following tables: Flanges ANSI and EN 1092-1 on pages 5–7	

Sensor Type II Dimensions

Remote Version in. (mm)



Mounted Version in. (mm)



IMPORTANT: Flange Sizes \leq 24 in., Standard: ANSI B16.5 Class 150 RF forged carbon steel; Optional: 300 lb forged carbon steel, 316 or 304 stainless steel

Flange Sizes $>$ 24 in., Standard: AWWA Class D Flanges RF forged carbon steel

Flange ANSI Class 150 Up to 24 in. ASME B16.5 / > 24 in. AWWA Class D (ASME 16.47)

Size DN		A Standard		A ISO*		B1		B2		D		K		d2 x n	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
1/4	6	6.7	170	—	—	9.0	228	11.3	288	3.5	89	2.4	61	0.6 x 4	16 x 4
5/16	8	6.7	170	—	—	9.0	228	11.3	288	3.5	89	2.4	61	0.6 x 4	16 x 4
3/8	10	6.7	170	—	—	9.0	228	11.3	288	3.5	89	2.4	61	0.6 x 4	16 x 4
1/2	15	6.7	170	7.9	200	9.4	238	11.7	298	3.5	89	2.4	61	0.6 x 4	16 x 4
3/4	20	6.7	170	7.9	200	9.4	238	11.7	298	3.9	99	2.8	71	0.6 x 4	16 x 4
1	25	8.9	225	7.9	200	9.4	238	11.7	298	4.3	109	3.1	79	0.6 x 4	16 x 4
1-1/4	32	8.9	225	7.9	200	10.0	253	12.3	313	4.6	117	3.5	89	0.6 x 4	16 x 4
1-1/2	40	8.9	225	7.9	200	10.0	253	12.3	313	5.0	127	3.9	99	0.6 x 4	16 x 4
2	50	8.9	225	7.9	200	10.0	253	12.3	313	6.0	152	4.8	122	0.8 x 4	19 x 4
2-1/2	65	11.0	280	7.9	200	10.7	271	13.0	331	7.0	178	5.5	140	0.8 x 4	19 x 4
3	80	11.0	280	7.9	200	10.7	271	13.0	331	7.5	191	6.0	152	0.8 x 4	19 x 4
4	100	11.0	280	9.8	250	10.9	278	13.3	338	9.0	229	7.5	191	0.8 x 8	19 x 8
5	125	15.7	400	9.8	250	11.7	298	14.1	358	10.0	254	8.5	216	0.9 x 8	22 x 8
6	150	15.7	400	11.8	300	12.2	310	14.6	370	11.0	279	9.5	241	0.9 x 8	22 x 8
8	200	15.7	400	13.8	350	13.3	338	15.7	398	13.5	343	11.8	300	0.9 x 8	22 x 8
10	250	19.7	500	17.7	450	14.3	362	16.6	422	16.0	406	14.3	363	1.0 x 12	25 x 12
12	300	19.7	500	19.7	500	16.7	425	19.1	485	19.0	483	17.0	432	1.0 x 12	25 x 12
14	350	19.7	500	21.7	550	17.7	450	20.1	510	21.0	533	18.8	478	1.1 x 12	28 x 12
16	400	23.6	600	23.6	600	18.7	475	21.1	535	23.5	597	21.3	541	1.1 x 16	28 x 16
18	450	23.6	600	23.6	600	19.7	500	22.0	560	25.0	635	22.8	579	1.3 x 16	32 x 16
20	500	23.6	600	23.6	600	20.7	525	23.0	585	27.5	699	25.0	635	1.3 x 20	32 x 20
24	600	23.6	600	23.6	600	23.1	588	25.5	648	32.0	813	29.5	749	1.4 x 20	35 x 20
28	700	23.6	600	27.6	700	24.6	625	27.0	685	36.5	927	34.0	864	1.4 x 28	35 x 28
30	750	31.5	800	29.5	750	25.6	650	28.0	710	38.8	986	36.0	914	1.4 x 28	35 x 28
32	800	31.5	800	31.5	800	26.9	683	29.3	743	41.8	1062	38.5	978	1.6 x 28	41 x 28
36	900	31.5	800	35.4	900	28.5	725	30.9	785	46.0	1168	42.8	1087	1.6 x 32	41 x 32
40	1000	31.5	800	39.4	1000	31.1	790	33.5	850	50.8	1290	47.3	1201	1.6 x 36	41 x 36
42	1050	39.4	1000	41.3	1050	32.5	825	34.8	885	53.0	1346	49.5	1257	1.6 x 36	41 x 36
48	1200	39.4	1000	47.2	1200	35.4	900	37.8	960	59.5	1511	56.0	1422	1.6 x 44	41 x 44
54	1350	39.4	1000	53.1	1350	38.4	975	40.7	1035	66.3	1684	62.8	1595	1.9 x 44	48 x 44
56	1400	39.4	1000	55.1	1400	39.4	1000	41.7	1060	68.8	1748	65.0	1651	1.9 x 48	48 x 48

Other sizes on request

IMPORTANT: ISO* sensor lay length according to ISO 20456

Flange ANSI Class 300 ASME B16.5

Size DN		A Standard		A ISO*		B1		B2		D		K		d2 x n	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
1/2	15	6.7	170	7.9	200	9.4	238	11.7	298	3.8	95	2.6	67	0.6 x 4	16 x 4
3/4	20	6.7	170	7.9	200	9.4	238	11.7	298	4.6	117	3.3	83	0.8 x 4	19 x 4
1	25	8.9	225	7.9	200	9.4	238	11.7	298	4.9	124	3.5	89	0.8 x 4	19 x 4
1-1/4	32	8.9	225	7.9	200	10.0	253	12.3	313	5.3	133	3.9	99	0.8 x 4	19 x 4
1-1/2	40	8.9	225	7.9	200	10.0	253	12.3	313	6.1	155	4.5	114	0.9 x 4	22 x 4
2	50	8.9	225	7.9	200	10.0	253	12.3	313	6.5	165	5.0	127	0.8 x 8	19 x 8
2-1/2	65	11.0	280	7.9	200	10.7	271	13.0	331	7.5	191	5.9	149	0.9 x 8	22 x 8
3	80	11.0	280	7.9	200	10.7	271	13.0	331	8.3	210	6.6	168	0.9 x 8	22 x 8
4	100	11.0	280	9.8	250	10.9	278	13.3	338	10.0	254	7.9	200	0.9 x 8	22 x 8
5	125	15.7	400	9.8	250	11.7	298	14.1	358	11.0	279	9.3	235	0.9 x 8	22 x 8
6	150	15.7	400	11.8	300	12.2	310	14.6	370	12.5	318	10.6	270	0.9 x 12	22 x 12
8	200	15.7	400	13.8	350	13.3	338	15.7	398	15.0	381	13.0	330	1.0 x 12	25 x 12
10	250	19.7	500	17.7	450	14.3	362	16.6	422	17.5	445	15.3	387	1.1 x 16	28 x 16
12	300	19.7	500	19.7	500	16.7	425	19.1	485	20.5	521	17.8	451	1.3 x 16	32 x 16
14	350	19.7	500	21.7	550	17.7	450	20.1	510	23.0	584	20.3	514	1.3 x 20	32 x 20
16	400	23.6	600	23.6	600	18.7	475	21.1	535	25.5	648	22.5	572	1.4 x 20	35 x 20
18	450	23.6	600	23.6	600	19.7	500	22.0	560	28.0	711	24.8	629	1.4 x 24	35 x 24
20	500	23.6	600	23.6	600	20.7	525	23.0	585	30.5	775	27.0	686	1.4 x 24	35 x 24
24	600	23.6	600	23.6	600	23.1	588	25.5	648	36.0	914	32.0	813	1.6 x 24	41 x 24

Other sizes on request

IMPORTANT: ISO* sensor lay length according to ISO 20456

Flange EN 1092-1 / PN 10

Size DN		A Standard		A ISO*		B1		B2		D		K		d2 x n	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
8	200	15.7	400	13.8	350	13.3	338	15.7	398	13.4	340	11.6	295	0.9 x 8	22 x 8
10	250	19.7	500	17.7	450	14.3	362	16.6	422	15.6	395	13.8	350	0.9 x 12	22 x 12
12	300	19.7	500	19.7	500	16.7	425	19.1	485	17.5	445	15.7	400	0.9 x 12	22 x 12
14	350	19.7	500	21.7	550	17.7	450	20.1	510	19.9	505	18.1	460	0.9 x 16	22 x 16
16	400	23.6	600	23.6	600	18.7	475	21.1	535	22.2	565	20.3	515	1.0 x 16	26 x 16
18	450	23.6	600	23.6	600	19.7	500	22.0	560	24.2	615	22.2	565	1.0 x 20	26 x 20
20	500	23.6	600	23.6	600	20.7	525	23.0	585	26.4	670	24.4	620	1.0 x 20	26 x 20
24	600	23.6	600	23.6	600	23.1	588	25.5	648	30.7	780	28.5	725	1.2 x 20	30 x 20
28	700	23.6	600	27.6	700	24.6	625	27.0	685	35.2	895	33.1	840	1.2 x 24	30 x 24
32	800	31.5	800	31.5	800	26.9	683	29.3	743	40.0	1015	37.4	950	1.3 x 24	33 x 24
36	900	31.5	800	35.4	900	28.5	725	30.9	785	43.9	1115	41.3	1050	1.3 x 28	33 x 28
40	1000	31.5	800	39.4	1000	31.1	790	33.5	850	48.4	1230	45.7	1160	1.4 x 28	36 x 28
48	1200	39.4	1000	47.2	1200	35.4	900	37.8	960	57.3	1455	54.3	1380	1.5 x 32	39 x 32
56	1400	39.4	1000	55.1	1400	39.4	1000	41.7	1060	65.9	1675	62.6	1590	1.7 x 36	42 x 36

Other sizes on request

IMPORTANT: ISO* sensor lay length according to ISO 20456

Flange EN 1092-1 / PN 16

Size DN		A Standard		A ISO*		B1		B2		D		K		d2 x n	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
1/4	6	6.7	170	—	—	9.0	228	11.3	288	3.5	90	2.4	60	0.6 x 4	14 x 4
5/16	8	6.7	170	—	—	9.0	228	11.3	288	3.5	90	2.4	60	0.6 x 4	14 x 4
3/8	10	6.7	170	—	—	9.0	228	11.3	288	3.5	90	2.4	60	0.6 x 4	14 x 4
1/2	15	6.7	170	7.9	200	9.4	238	11.7	298	3.7	95	2.6	65	0.6 x 4	14 x 4
3/4	20	6.7	170	7.9	200	9.4	238	11.7	298	4.1	105	3.0	75	0.6 x 4	14 x 4
1	25	8.9	225	7.9	200	9.4	238	11.7	298	4.5	115	3.3	85	0.6 x 4	14 x 4
1-1/4	32	8.9	225	7.9	200	10.0	253	12.3	313	5.5	140	3.9	100	0.7 x 4	18 x 4
1-1/2	40	8.9	225	7.9	200	10.0	253	12.3	313	5.9	150	4.3	110	0.7 x 4	18 x 4
2	50	8.9	225	7.9	200	10.0	253	12.3	313	6.5	165	4.9	125	0.7 x 4	18 x 4
2-1/2	65	11.0	280	7.9	200	10.7	271	13.0	331	7.3	185	5.7	145	0.7 x 8	18 x 8
3	80	11.0	280	7.9	200	10.7	271	13.0	331	7.9	200	6.3	160	0.7 x 8	18 x 8
4	100	11.0	280	9.8	250	10.9	278	13.3	338	8.7	220	7.1	180	0.7 x 8	18 x 8
5	125	15.7	400	9.8	250	11.7	298	14.1	358	9.8	250	8.3	210	0.7 x 8	18 x 8
6	150	15.7	400	11.8	300	12.2	310	14.6	370	11.2	285	9.4	240	0.9 x 8	22 x 8
8	200	15.7	400	13.8	350	13.3	338	15.7	398	13.4	340	11.6	295	0.9 x 12	22 x 12
10	250	19.7	500	17.7	450	14.3	362	16.6	422	15.9	405	14.0	355	1.0 x 12	26 x 12
12	300	19.7	500	19.7	500	16.7	425	19.1	485	18.1	460	16.1	410	1.0 x 12	26 x 12
14	350	19.7	500	21.7	550	17.7	450	20.1	510	20.5	520	18.5	470	1.0 x 16	26 x 16
16	400	23.6	600	23.6	600	18.7	475	21.1	535	22.8	580	20.7	525	1.2 x 16	30 x 16
18	450	23.6	600	23.6	600	19.7	500	22.0	560	25.2	640	23.0	585	1.2 x 20	30 x 20
20	500	23.6	600	23.6	600	20.7	525	23.0	585	28.1	715	25.6	650	1.3 x 20	33 x 20
24	600	23.6	600	23.6	600	23.1	588	25.5	648	33.1	840	30.3	770	1.4 x 20	36 x 20
28	700	23.6	600	27.6	700	24.6	625	27.0	685	35.8	910	33.1	840	1.4 x 24	36 x 24
32	800	31.5	800	31.5	800	26.9	683	29.3	743	40.4	1025	37.4	950	1.5 x 24	39 x 24
36	900	31.5	800	35.4	900	28.5	725	30.9	785	44.3	1125	41.3	1050	1.5 x 28	39 x 28
40	1000	31.5	800	39.4	1000	31.1	790	33.5	850	49.4	1255	46.1	1170	1.7 x 28	42 x 28
48	1200	39.4	1000	47.2	1200	35.4	900	37.8	960	58.5	1485	54.7	1390	1.9 x 32	48 x 32
56	1400	39.4	1000	55.1	1400	39.4	1000	41.7	1060	66.3	1685	62.6	1590	1.9 x 36	48 x 36

Other sizes on request

IMPORTANT: ISO* sensor lay length according to ISO 20456

Flange EN 1092-1 / PN 25

Size DN		A Standard		A ISO*		B1		B2		D		K		d2 x n	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
1/2	15	6.7	170	7.9	200	9.4	238	11.7	298	3.7	95	2.6	65	0.6 x 4	14 x 4
3/4	20	6.7	170	7.9	200	9.4	238	11.7	298	4.1	105	3.0	75	0.6 x 4	14 x 4
1	25	8.9	225	7.9	200	9.4	238	11.7	298	4.5	115	3.3	85	0.6 x 4	14 x 4
1-1/4	32	8.9	225	7.9	200	10.0	253	12.3	313	5.5	140	3.9	100	0.7 x 4	18 x 4
1-1/2	40	8.9	225	7.9	200	10.0	253	12.3	313	5.9	150	4.3	110	0.7 x 4	18 x 4
2	50	8.9	225	7.9	200	10.0	253	12.3	313	6.5	165	4.9	125	0.7 x 4	18 x 4
2-1/2	65	11.0	280	7.9	200	10.7	271	13.0	331	7.3	185	5.7	145	0.7 x 4	18 x 8
3	80	11.0	280	7.9	200	10.7	271	13.0	331	7.9	200	6.3	160	0.7 x 8	18 x 8
4	100	11.0	280	9.8	250	10.9	278	13.3	338	9.3	235	7.5	190	0.9 x 8	22 x 8
5	125	15.7	400	9.8	250	11.7	298	14.1	358	10.6	270	8.7	220	1.0 x 8	26 x 8
6	150	15.7	400	11.8	300	12.2	310	14.6	370	11.8	300	9.8	250	1.0 x 8	26 x 8
8	200	15.7	400	13.8	350	13.3	338	15.7	398	14.2	360	12.2	310	1.0 x 8	26 x 12
10	250	19.7	500	17.7	450	14.3	362	16.6	422	16.7	425	14.6	370	1.2 x 12	30 x 12
12	300	19.7	500	19.7	500	16.7	425	19.1	485	19.1	485	16.9	430	1.2 x 12	30 x 16
14	350	19.7	500	21.7	550	17.7	450	20.1	510	21.9	555	19.3	490	1.3 x 16	33 x 16
16	400	23.6	600	23.6	600	18.7	475	21.1	535	24.4	620	21.7	550	1.4 x 16	36 x 16
18	450	23.6	600	23.6	600	19.7	500	22.0	560	26.4	670	23.6	600	1.4 x 20	36 x 20
20	500	23.6	600	23.6	600	20.7	525	23.0	585	28.7	730	26.0	660	1.4 x 20	36 x 20
24	600	23.6	600	23.6	600	23.1	588	25.5	648	33.3	845	30.3	770	1.5 x 20	39 x 20
28	700	23.6	600	27.6	700	24.6	625	27.0	685	37.8	960	34.4	875	1.7 x 24	42 x 24
32	800	31.5	800	31.5	800	26.9	683	29.3	743	42.7	1085	39.0	990	1.9 x 24	48 x 24
36	900	31.5	800	35.4	900	28.5	725	30.9	785	46.7	1185	42.9	1090	1.9 x 28	48 x 28
40	1000	31.5	800	39.4	1000	31.1	790	33.5	850	52.0	1320	47.6	1210	2.2 x 28	56 x 28

Other sizes on request

IMPORTANT: ISO* sensor lay length according to ISO 20456

Flange EN 1092-1 / PN 40

Size DN		A Standard		A ISO*		B1		B2		D		K		d2 x n	
inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
1/2	15	6.7	170	7.9	200	9.4	238	11.7	298	3.7	95	2.6	65	0.6 x 4	14 x 4
3/4	20	6.7	170	7.9	200	9.4	238	11.7	298	4.1	105	3.0	75	0.6 x 4	14 x 4
1	25	8.9	225	7.9	200	9.4	238	11.7	298	4.5	115	3.3	85	0.6 x 4	14 x 4
1-1/4	32	8.9	225	7.9	200	10.0	253	12.3	313	5.5	140	3.9	100	0.7 x 4	18 x 4
1-1/2	40	8.9	225	7.9	200	10.0	253	12.3	313	5.9	150	4.3	110	0.7 x 4	18 x 4
2	50	8.9	225	7.9	200	10.0	253	12.3	313	6.5	165	4.9	125	0.7 x 4	18 x 4
2-1/2	65	11.0	280	7.9	200	10.7	271	13.0	331	7.3	185	5.7	145	0.7 x 4	18 x 8
3	80	11.0	280	7.9	200	10.7	271	13.0	331	7.9	200	6.3	160	0.7 x 8	18 x 8
4	100	11.0	280	9.8	250	10.9	278	13.3	338	9.3	235	7.5	190	0.9 x 8	22 x 8
5	125	15.7	400	9.8	250	11.7	298	14.1	358	10.6	270	8.7	220	1.0 x 8	26 x 8
6	150	15.7	400	11.8	300	12.2	310	14.6	370	11.8	300	9.8	250	1.0 x 8	26 x 8
8	200	15.7	400	13.8	350	13.3	338	15.7	398	14.8	375	12.6	320	1.2 x 8	30 x 12
10	250	19.7	500	17.7	450	14.3	362	16.6	422	17.7	450	15.2	385	1.3 x 12	33 x 12
12	300	19.7	500	19.7	500	16.7	425	19.1	485	20.3	515	17.7	450	1.3 x 12	33 x 16
14	350	19.7	500	21.7	550	17.7	450	20.1	510	22.8	580	20.1	510	1.4 x 16	36 x 16
16	400	23.6	600	23.6	600	18.7	475	21.1	535	26.0	660	23.0	585	1.5 x 16	39 x 16
18	450	23.6	600	23.6	600	19.7	500	22.0	560	27.0	685	24.0	610	1.5 x 20	39 x 20
20	500	23.6	600	23.6	600	20.7	525	23.0	585	29.7	755	26.4	670	1.7 x 20	42 x 20
24	600	23.6	600	23.6	600	23.1	588	25.5	648	35.0	890	31.3	795	1.9 x 20	48 x 20

Other sizes on request

IMPORTANT: ISO* sensor lay length according to ISO 20456

Weight and Flow Range

Size		Estimated Weight with M2000	Flow Range	
in.	DN		US	Metric
1/4	6	8 (3.5)	0.0134–5.4 GPM	0.051–20.4 l/min
5/16	8	8 (3.5)	0.0239–9.6 GPM	0.09–36.2 l/min
3/8	10	8 (3.5)	0.0373–14.9 GPM	0.141–57 l/min
1/2	15	10 (4.5)	0.084–33.6 GPM	0.318–127 l/min
3/4	20	10 (4.5)	0.149–60 GPM	0.57–226 l/min
1	25	11 (5)	0.233–93 GPM	0.88–353 l/min
1-1/4	32	13 (6)	0.382–153 GPM	1.45–579 l/min
1-1/2	40	15.5 (7)	0.6–239 GPM	2.26–905 l/min
2	50	19 (8.5)	0.93–373 GPM	3.53–1,414 l/min
2-1/2	65	27.5 (12.5)	1.58–631 GPM	0.358–143 m ³ /h
3	80	31 (14)	2.39–956 GPM	0.54–217 m ³ /h
4	100	42 (19)	3.73–1,494 GPM	0.85–339 m ³ /h
5	125	53 (24)	5.8–2,334 GPM	1.33–530 m ³ /h
6	150	60.5 (27.5)	8.4–3,361 GPM	1.91–763 m ³ /h
8	200	87 (39.5)	14.9–5,975 GPM	3.39–1,357 m ³ /h
10	250	129 (58.5)	23.3–9,336 GPM	5.3–2,121 m ³ /h
12	300	204 (92.5)	33.6–13,444 GPM	7.6–3,054 m ³ /h
14	350	262 (119)	45.7–18,299 GPM	10.4–4,156 m ³ /h
16	400	344 (156)	60–23,901 GPM	13.6–5,429 m ³ /h
18	450	397 (180)	76–30,250 GPM	17.2–6,870 m ³ /h
20	500	470 (213)	93–37,345 GPM	21.2–8,482 m ³ /h
22	550	549 (249)	113–45,188 GPM	25.7–10,263 m ³ /h
24	600	617 (280)	134–53,777 GPM	30.5–12,214 m ³ /h
28	700	—	183–73,197 GPM	41.6–16,625 m ³ /h
30	750	930 (422)	210–84,027 GPM	47.7–19,085 m ³ /h
32	800	1171 (531)	239–95,604 GPM	54.3–21,714 m ³ /h
36	900	1378 (625)	302–120,999 GPM	69–27,482 m ³ /h
40	1000	—	373–149,381 GPM	85–33,928 m ³ /h
48	1200	1788 (811)	538–215,109 GPM	122–48,857 m ³ /h
56	1400	—	732–292,787 GPM	166–66,499 m ³ /h
60	1500	2112 (958)	840–336,108 GPM	191–76,338 m ³ /h
64	1600	2339 (1061)	956–382,416 GPM	217–86,856 m ³ /h
72	1800	3219 (1460)	1210–483,996 GPM	275–109,927 m ³ /h
78	2000	4101 (1860)	1494–597,525 GPM	339–135,713 m ³ /h

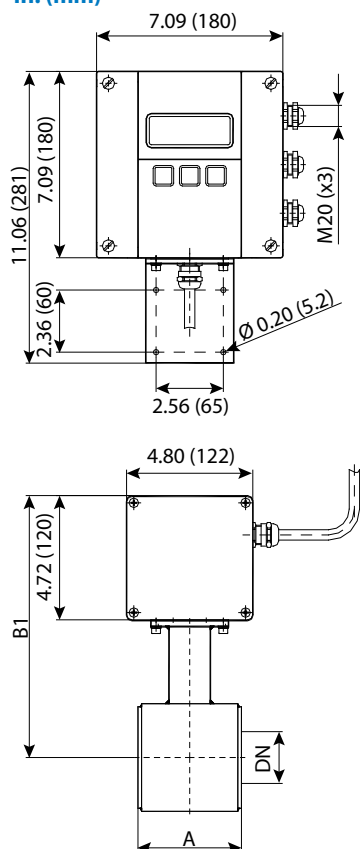
Sensor Type III Specifications

Thanks to its very short lay length, the sensor type III is often the right alternative to a lot of applications. Delivered with a PTFE liner, the sensor type III has a standard nominal pressure of PN 40.

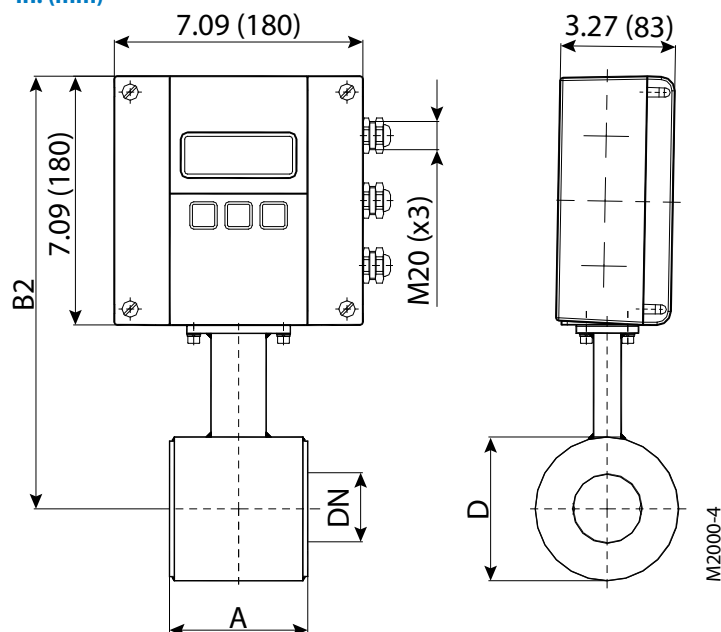
Size	1–4 in. (DN 25–100)	
Process Connection	Wafer connection (in-between flange mounting)	
Nominal Pressure	580 psi (40 bar)	
Protection Class	NEMA 4X (IP67), optional NEMA 6P (IP68)	
Minimum Conductivity	5 µS/cm (20 µS/cm for demineralized water)	
Liner Materials	PTFE	
Electrode Material	Hastelloy C (Standard), Tantal, Platinum / Gold Plated, Platinum / Rhodium	
Housing	Carbon Steel / optional stainless steel	
Lay Length	1–2 in. (DN 25–50)	4 in. (100 mm)
	2-1/2–4 in. (DN 65–100)	6 in. (150 mm)

Sensor Type III Dimensions

Remote Version in. (mm)



Mounted Version in. (mm)



in.	DN	A	B1	B2	D
1	25	3.94 (100)	9.37 (238)	7.24 (184)	2.91 (74)
1-1/4	32	3.94 (100)	9.57 (243)	7.44 (189)	3.31 (84)
1-1/2	40	3.94 (100)	9.76 (248)	7.64 (194)	3.70 (94)
2	50	3.94 (100)	9.96 (253)	7.83 (199)	4.09 (104)
2-1/2	65	5.91 (150)	10.47 (266)	8.35 (212)	5.08 (129)
3	80	5.91 (150)	10.67 (271)	8.54 (217)	5.51 (140)
4	100	5.91 (150)	10.98 (279)	8.86 (225)	6.14 (156)

580 psi (40 bar)

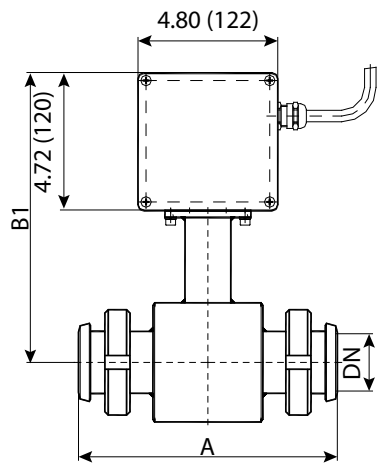
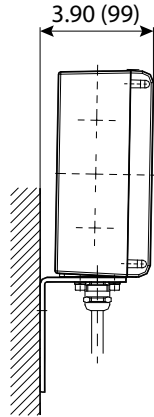
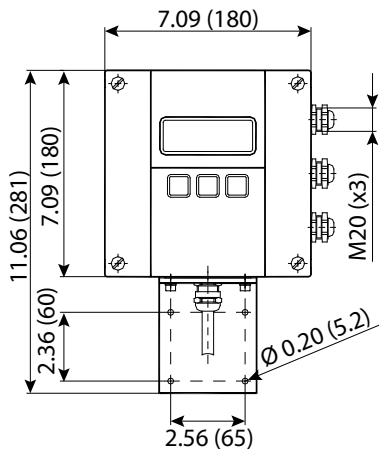
Sensor with Sanitary Process Connections Specifications

The sensor model is available with Tri-Clamp® BS4825/ISO2852, DIN11851, and more process connections. The sanitary sensor is delivered in a stainless steel housing and with PTFE/PFA lining.

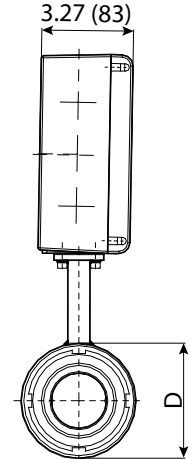
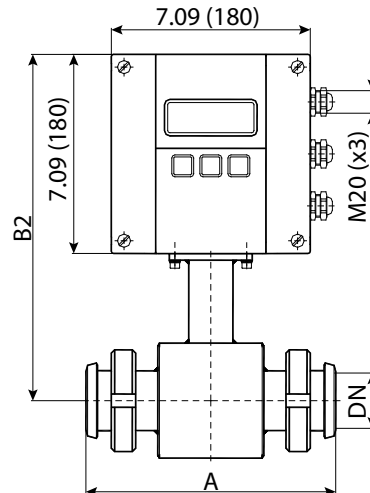
Size	3/8–4 in. (DN 10–100)		
Process Connection	Tri-Clamp BS4825/ISO2852, DIN 11851, customer specified, and more		
Nominal Pressure	145/230 psi (10/16 bar)		
Protection Class	NEMA 4X (IP67), optional NEMA 6P (IP68)		
Minimum Conductivity	5 µS/cm (20 µS/cm for demineralized water)		
Liner Materials	PTFE/PFA	–40 to 302 °F (–40 to 150 °C)	
Electrode Material	Standard: Hastelloy C; Optional: Tantal, Platinum / Gold plated, Platinum / Rhodium		
Measuring tube	Stainless steel, lined by different materials		
Housing	Standard: Carbon Steel; Optional: Stainless Steel		
Lay Length	Tri-Clamp Connection	3/8–2 in. (DN 10–50)	5.71 in. (145 mm)
		2-1/2–4 in. (DN 65–100)	7.87 in. (200 mm)
	DIN 11851 Connection	3/8–3/4 in. (DN 10–20)	6.69 in. (170 mm)
		1–2 in. (DN 25–50)	8.86 in. (225 mm)
		2-1/2–4 in. (DN 65–100)	11.02 in. (280 mm)

DIN 11851 Connection Dimensions

Remote Version in. (mm)



Mounted Version in. mm

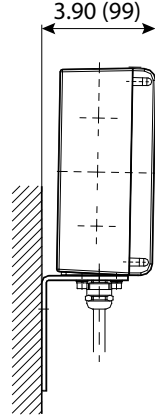
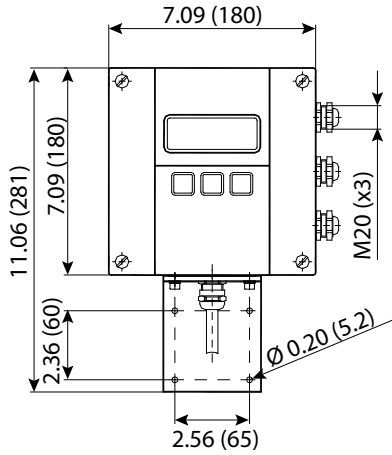


in.	DN	A	B1	B2	D
3/8	10	6.69 (170)	9.37 (238)	7.24 (184)	2.91 (74)
1/2	15	6.69 (170)	9.37 (238)	7.24 (184)	2.91 (74)
3/4	20	6.69 (170)	9.37 (238)	7.24 (184)	2.91 (74)
1	25	8.86 (225)	9.37 (238)	7.24 (184)	2.91 (74)
1-1/4	32	8.86 (225)	9.57 (243)	7.44 (189)	3.31 (84)
1-1/2	40	8.86 (225)	9.76 (248)	7.64 (194)	3.70 (94)
2	50	8.86 (225)	9.96 (253)	7.83 (199)	4.09 (104)
2-1/2	65	11.02 (280)	10.47 (266)	8.35 (212)	5.08 (129)
3	80	11.02 (280)	10.67 (271)	8.54 (217)	5.51 (140)
4	100	11.02 (280)	10.98 (279)	8.86 (225)	6.14 (156)

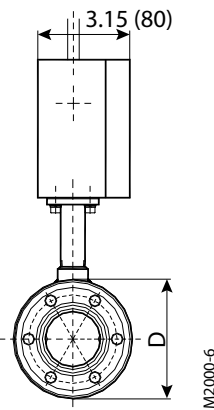
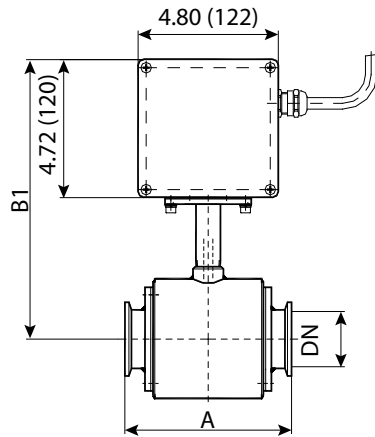
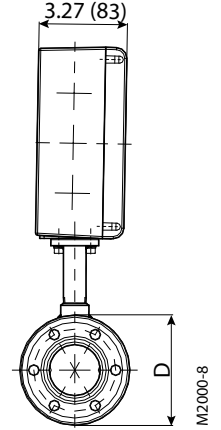
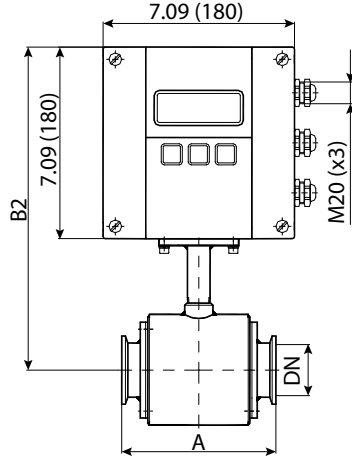
230 psi (16 bar)

Tri-Clamp Connection Dimensions

Remote Version in. (mm)



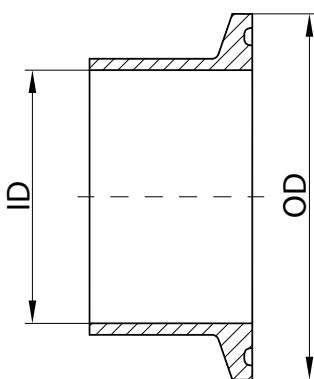
Mounted Version in. (mm)



in.	DN	A	B1	B2	D
3/8	10	5.71 (145)	8.98 (228)	7.52 (191)	2.91 (74)
1/2	15	5.71 (145)	8.98 (228)	7.52 (191)	2.91 (74)
3/4	20	5.71 (145)	8.98 (228)	7.52 (191)	2.91 (74)
1	25	5.71 (145)	8.98 (228)	7.52 (191)	2.91 (74)
1-1/2	40	5.71 (145)	9.37 (238)	7.91 (201)	3.70 (94)
2	50	5.71 (145)	9.57 (243)	8.11 (206)	4.09 (104)
2-1/2	65	7.87 (200)	10.08 (256)	8.62 (219)	5.08 (129)
3	80	7.87 (200)	10.28 (261)	8.82 (224)	5.51 (140)
4	100	7.87 (200)	10.59 (269)	9.13 (232)	6.14 (156)

150 psi (10 bar)

Tri-Clamp Connection

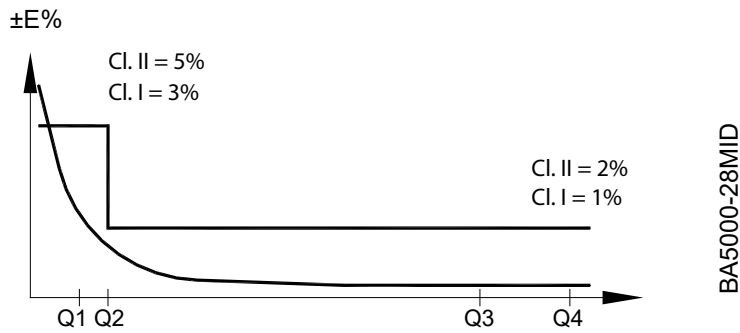


BS4825					ISO2852				
Size	OD		ID		Size	OD		ID	
in.	in.	mm	in.	mm	DN	in.	mm	in.	mm
—	—	—	—	—	10	0.98	25.0	0.55	14.0
1/2	0.98	25.0	0.37	9.4	15	1.99	50.5	0.71	18.1
3/4	0.98	25.0	0.62	15.75	20	1.99	50.5	0.90	22.9
1	1.99	50.5	0.87	22.1	25	1.99	50.5	1.13	28.7
—	—	—	—	—	32	2.52	64.0	1.51	38.4
1-1/2	1.99	50.5	1.37	34.8	40	2.52	64.0	1.74	44.3
2	2.52	64.0	1.87	47.5	50	3.05	77.5	2.22	56.3
2-1/2	3.05	77.5	2.37	60.2	65	3.58	91.0	2.84	72.1
3	3.58	91.0	2.87	72.9	80	4.17	106.0	3.32	84.3
4	4.69	119.0	3.83	97.4	100	5.12	130.0	4.32	109.7

Nominal Pressure 145 psi (10 bar)

OIML APPROVED METER

The M2000 is type approved according to the international water meter standards OIML R49. The meter is approved as Class I and Class II for the detector sizes 2...28 inches (DN 50...800).

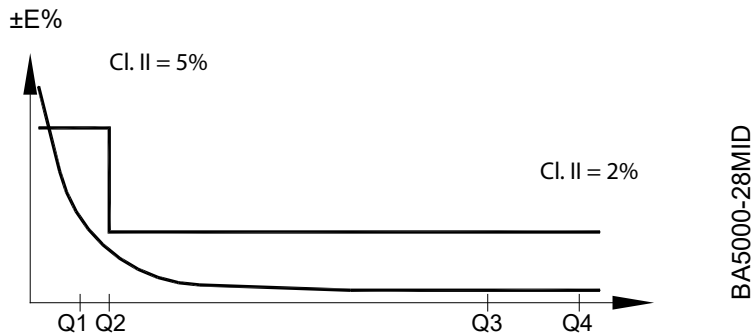


Q2/Q1 = 1.6 and Q4/Q3 = 1.25

Meter Size		Flow Rates [m ³ /h]				Ratio Q3/Q1
		Q1	Q2	Q3	Q4	
DN 50	2 in.	0.252	0.4032	63	78.75	250
DN 65	2-1/2 in.	0.4	0.64	100	125	250
DN 80	3 in.	0.64	1.024	160	200	250
DN 100	4 in.	1	1.6	250	312.5	250
DN 125	5 in.	1.6	2.56	400	500	250
DN 150	6 in.	2.52	4.032	630	787.5	250
DN 200	8 in.	4	6.4	1000	1250	250
DN 250	10 in.	6.4	10.24	1600	2000	250
DN 300	12 in.	10	16	2500	3125	250
DN 350	14 in.	10	16	2500	3125	250
DN 400	16 in.	16	25.6	4000	5000	250
DN 450	18 in.	25.2	40.32	6300	7875	250
DN 500	20 in.	25.2	40.32	6300	7875	250
DN 600	24 in.	25.2	40.32	6300	7875	250
DN 800	28 in.	40	64	10000	12500	250
OIML R49	Class 1 and Class 2					

MID APPROVED METER

The M2000 is type approved according to Directive 2004/22/EC of the European Parliament and Council of March 31, 2004 Measuring Instruments (MID) Annex MI-001. The meter is approved for the detector sizes 2...28 inches (DN 50...800).



Q2/Q1 = 1.6 and Q4/Q3 = 1.25

Meter Size		Flow Rates [m ³ /h]				Ratio Q3/Q1
		Q1	Q2	Q3	Q4	
DN 50	2 in.	0.252	0.4032	63	78.75	250
DN 65	2-1/2 in.	0.4	0.64	100	125	250
DN 80	3 in.	0.64	1.024	160	200	250
DN 100	4 in.	1	1.6	250	312.5	250
DN 125	5 in.	1.6	2.56	400	500	250
DN 150	6 in.	2.52	4.032	630	787.5	250
DN 200	8 in.	4	6.4	1000	1250	250
DN 250	10 in.	6.4	10.24	1600	2000	250
DN 300	12 in.	10	16	2500	3125	250
DN 350	14 in.	10	16	2500	3125	250
DN 400	16 in.	16	25.6	4000	5000	250
DN 450	18 in.	25.2	40.32	6300	7875	250
DN 500	20 in.	25.2	40.32	6300	7875	250
DN 600	24 in.	25.2	40.32	6300	7875	250
DN 800	28 in.	40	64	10000	12500	250
MID MI-001						

The conformity declaration of above certificate is according to module B (type approval) and D (quality insurance of production).

PART NUMBER CONSTRUCTION

ModMAG® Model M2000 Model Code

General Area		P	M	A	B	H	I	C	D	B	A	
Size												
DN 6	14 IN.	Inner PFA / 304 SST										
DN 8	5/8 IN.	Inner PFA / 304 SST										
DN 10	3/8 IN.	Inner PFA / 304 SST										
DN 15	1/2 IN.											
DN 20	3/4 IN.											
DN 25	1 IN.											
DN 32	1-1/4 IN.											
DN 40	1-1/2 IN.											
DN 50	2 IN.											
DN 65	2-1/2 IN.											
DN 80	3 IN.											
DN 100	4 IN.											
DN 150	6 IN.											
DN 200	8 IN.											
DN 250	10 IN.											
DN 300	12 IN.											
DN 350	14 IN.											
DN 400	16 IN.											
DN 450	18 IN.											
DN 500	20 IN.											
DN 600	24 IN.											
DN 700	28 IN.											
DN 800	32 IN.											
DN 900	36 IN.											
DN 1000	40 IN.											
DN 1200	48 IN.											
DN 1400	56 IN.											
DN 1600	64 IN.											
Process connection												
EN 1092-1 PN 40		FEE										
EN 1092-1 PN 25		FED										
EN 1092-1 PN 16		FEC										
EN 1092-1 PN 10		FEB										
ASME Class 300		F8B										
ASME Class 150		FAA										
TiClamp ISO 2882		TAE										
TiClamp ISO 4825		TAB										
Threads DIN 11851		DAA										
Wafer		WAA										
Flange and Housing material												
Carbon Steel (Standard)		C1										
Carbon Steel w/ CDM Part		C2										
304 Stainless Steel Connection / Housing		S0										
316 Stainless Steel Connection / Housing		S7										
Carbon Steel Process Connections (Std. Paint) / 316 Stainless Steel Housing		C4										
Line Material												
Hard Rubber		H										
PTFE for sizes > DN10 (3/8 IN.)		P										
PFA DN 6...DN 10 (1/4...3/8 IN.) with PFA liner		A										
ETFE for sizes > DN25 (1.0 IN.)		T										
Electrode / Measuring Electrode, Grounding												
Hastelloy C-22 (Standard / Measuring Empty pipe & Grounding)		A										
Hastelloy C-22 (Standard / Measuring Empty pipe)		J										
AISI 316L/307L		B										
Tantalum		C										
Platinum/Rhodium		D										
Grounding Ring												
No Grounding Rings		X										
304 Stainless Steel Grounding Rings		A										
316 Stainless Steel Grounding Rings		B										
Meter Labeling												
Standard		B										
ISO 22066		D										
Transmitter Power Supply Hardware												
100/240V AC, Meter-Mounted		SA	AA	C								
100/240V AC, Remote-Mounted		RS	AA	C								
12...32V DC, Meter-Mounted		SA	AB	C								
12...32V DC, Remote-Mounted		RA	AB	C								
Enclosure (for remote mounted version)												
Aluminum Enclosure: IP67 (Type 6/A) Rating		A										
Aluminum Enclosure: IP68 (Type 6/P) Rating (submersible option)		B										
Stainless Steel Enclosure: IP67 (Type 6/A) Rating		C										
Stainless Steel Enclosure: IP68 (Type 6/P) Rating (submersible option)		D										
None 1 Used for "Sensor-Mounted" Transmitters Configurations												
None 1 Used for "Sensor-Mounted" Transmitters Configuration												
Input/Output Channel												
Standard Input/Output		D	B	A								
Communications												
Standard Communication (RS232 Modbus RTU)		B										
Modbus RTU (RS-485)		L										
HART		F										
Profibus DP		E										
Modbus TCP/IP		G										
EtherNet/IP, ODVA		H										
M-Bus wired		M										
BACnet/IP		N										
BACnet MS/TP		O										
Wiring Method												
Twist Tight; 5 ft. (1.52 m)		TF										
Twist Tight; 10 ft. (3.05 m)		TH										
Twist Tight; 25 ft. (7.62 m)		TJ										
Twist Tight; 75 ft. (22.86 m)		TK										
None 1 No Endpoint (Standard)		NS										
Units												
Gallons/gallons per minute (North America Standard)		NA										
Gallons/cubic feet per minute		NC										
Gallons/cubic meters per second		ND										
Cubic Meters/gallons per minute		NE										
None 1		N0										
Cubic Feet/gallons per minute		NK										
Cubic Feet/cubic feet per minute		NL										
Cubic Feet/cubic meters per hour		NI										
Liters/gallons per minute		NS										
Million Gallons/gallons per minute		NT										
Gallons/millions gallons per day		NU										
Acres Feet/gallons per minute		NV										
Second Foot Day/cubic feet per second		NW										
Standard (Default Metric units based on size)		EA										
m ³ /s and m ³		EB										
m ³ /min and m ³		EC										
m ³ /h and m ³		ED										
L/s and L		EE										
L/min and L		EF										
L/h and L		EG										
Factory & Output												
0.2% 3-Point Calibration; Factory (Standard)		F										
0.2% 3-Point Calibration in Factory / Stainless steel Tag		S										
0.5% 1-Point Calibration; Factory		L										
0.5% 1-Point Calibration in Factory / Stainless steel Tag		M										
O/MAL R49 Cl 1 TYPE CALIBRATED; 3PT; Q1-Q3		N										
3rd Party Calibrated		S										
3rd Party Calibrated w/ Stainless Steel Tag		T										
State of Kansas Certified (North America only)		K										

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