

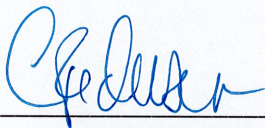
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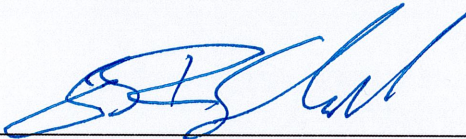
City of Duluth, Minnesota Construction Standards

Public Works & Utilities
Engineering Division
Duluth, MN
April 5, 2019



CITY APPROVAL


APPROVED CHIEF ENGINEER OF TRANSPORTATION 4/5/19
DATE


APPROVED CHIEF ENGINEER OF UTILITIES 4-5-19
DATE

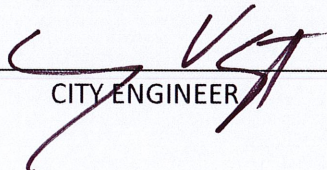

APPROVED CITY ENGINEER 4-5-19
DATE

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CITY OF DULUTH GENERAL REQUIREMENTS

S-1 INDEMNITY AND INSURANCE PROVISIONS

Reviewed 3/12/19

The Contractor will be required to carry insurance of the kinds and in the amounts hereinafter specified. The Contractor shall not commence work under the Contract until he has obtained all the insurance required by these specifications and until such insurance approved by the City Attorney, nor shall the Contractor allow any subcontractor to commence work on his subcontract until all similar insurance required of the subcontractor shall have been so obtained and approved. Except as superseded by the Contract, the indemnity and insurance provisions shall meet the following:

A. Indemnity

1. The Contractor shall defend, indemnify and save the City harmless from all costs, charges, damages, and loss of any kind that may grow out of the matters covered by this contract. Said obligation does not include indemnification of the City for claims of liability arising out of the sole negligent or intentional acts or omissions of City but shall include but not be limited to the obligation to defend, indemnify and save harmless the City in all cases where claims of liability against the City arise out of acts or omissions of Contractor such as, and including but not limited to, the failure to supervise, the failure to warn, the failure to prevent such act or omission by Contractor and any other such source of liability.
2. The Contractor shall hold and save the City, its officers, employees, representatives and agents, and the Architect, harmless from liability of any nature or kind, including costs and expenses, for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the City, unless otherwise specifically stipulated in the Technical Specifications.

B. Insurance

1. Contractor shall provide satisfactory evidence that it has secured the following insurance in at least the amounts specified from insurance companies authorized to do business in the state of Minnesota, which insurance shall indemnify Contractor and City from all liability described in Paragraph A above, subject to provisions below.
 - a. Workers' compensation insurance in accordance with the laws of the State of Minnesota.
 - b. Public Liability and Automobile Liability Insurance with limits not less than **\$1,500,000** Single Limit, and twice the limits provided when a claim arises out of the release or threatened release of a hazardous substance*; shall be with a company approved by the city of Duluth; and shall provide for the following: Liability for Premises, Operations, Completed Operations, Independent Contractors, and Contractual Liability.
 - c. City of Duluth shall be named as **Additional Insured** under the Public Liability, and Automobile Liability*, or as an alternate, Contractor may provide Owners-Contractors Protective policy, naming itself and the City of Duluth. Contractor to provide a Certificate or Certificates of Insurance evidencing all required coverage with 30-days'

notice of cancellation, non-renewal or material change provisions included. The City of Duluth does not represent or guarantee that these types or limits of coverage are adequate to protect the Contractor's interests and liabilities.

**An umbrella policy with a "following form" provision is acceptable if written verification is provided that the underlying policy names the City of Duluth as an additional insured.*

- d. In addition to the insurance requirements above, the Contractor shall provide proof of Builders Risk Insurance on a "Multi-Peril-All-Risk" basis, which includes theft of material not installed and glass breakage. Contractor(s) is (are) liable for losses within deductible coverage.
2. The insurance required herein shall be maintained in full force and effect during the life of this Agreement and shall protect the City, the Contractor, and their employees, agents and representatives from claims and damages including but not limited to personal injury and death and any act or failure to act by Contractor, its employees, agents and representatives in the negligent performance of work covered by this Agreement.
3. Certificates showing that Contractor is carrying the above described insurance in the specified amounts shall be furnished to the City prior to the execution of this Contract and a certificate showing continued maintenance of such insurance shall be on file with the City during the term of this Contract. In the event any work contemplated by the Contract is subcontracted, the Contractor shall have the duty to assure that all Subcontractors provide insurance in accord with the minimum requirements herein imposed on the Contractor prior to commencement of any work on a subcontract.
4. Contractor shall be required to provide insurance meeting the requirements of this Paragraph B unless Contractor successfully demonstrates to the satisfaction of the City Attorney, in the exercise of his or her discretion, that such insurance is not reasonably available in the market. If Contractor demonstrates to the satisfaction of the City Attorney that such insurance is not reasonably available, the City Attorney may approve an alternative form of insurance which is reasonably available in the market which he or she deems to provide the highest level of insurance protection to the City which is reasonably available.

S-2 PUBLIC WORKS AND UTILITIES REGULATIONS

Prior to beginning work, the contractor shall acquaint himself with all regulations and requirements of the City of Duluth Public Works & Utilities Department that may apply to the proposed work. All work shall be open at all times to inspection by the Public Works & Utilities Department. The Contractor shall notify the Engineer not less than two working days before beginning construction. The operation of all valves on the existing distribution systems shall be performed only by the Public Works & Utilities Department. The Contractor shall give 24 hours' notice to the Public Works & Utilities Department prior to the need for the operation of any existing water valves or the need for any water main shutdowns by contacting 730-5200.

S-3 MATERIALS AND WORK TO BE FURNISHED BY THE PUBLIC WORKS AND UTILITIES DEPARTMENT

The Public Works & Utilities Department will furnish the following materials and work on this project at no cost to the Contractor. Contractor is to excavate and backfill in order to allow the Department to perform said work.

- A. Shut down water and gas mains and services as necessary to allow contractor to furnish and install water and gas connections.
- B. Sample and test for bacteria for new public water mains. In the case of a failed bacteria test, the City reserves the right to charge the Contractor for retests.
- C. Supply iron pipe curb box materials as shown on details W-5, W-5A, W-7, W-8, W-8A, W-8B, and W-9.
- D. Supply monument casting assembly as shown on details SUR-1 and SUR-2.

S-4 INSPECTION OF MATERIALS

All materials to be used in the construction will be inspected by the Engineer prior to installation. The Contractor shall furnish any necessary labor or equipment requested by the Engineer for the inspection. No materials shall be placed until they have been inspected and approved. Refer to section 1502 of these standards for shop drawing review process.

S-5 CONSTRUCTION INSPECTION

The Contractor shall provide adequate notice and coordination of planned work activities so that construction inspection can be provided by the Engineer. Any work that is performed by the Contractor (or Subcontractor) without the Engineer's inspector present will be considered unacceptable and no payment will be made. Refer to section 1511 of these standards for safe access to work for inspection and record survey.

S-6 USE OF WATER FROM CITY HYDRANTS

All water taken from City hydrants, except for that water related to water main construction shall be metered and a charge will be made for the amount used. The Contractor must make arrangements with the Public Works and Utilities Department at 730-5200 to get the necessary permit, valve and meter, prior to using the hydrant for drawing water.

S-7 DRUG AND ALCOHOL TESTING FOR GAS WORK

This contract will require compliance with Federal regulations which requires pre-employment, post-accident, and reasonable cause drug and alcohol testing of employees, contractors and other workers. Random drug testing shall also be required under this contract.

Prior to the issuance of the Notice to Proceed, contractors/vendors performing work covered by the DOT drug and alcohol testing rules as set forth in 49 CFR Part 199 and Part 40, shall provide the following documentation for review for compliance with RSPA/DOT regulations:

1. Anti-Drug Plan and any addenda issued thereto.

2. Alcohol Misuse Prevention Plan and any addenda issued thereto.
3. Minnesota Office of Pipeline Safety Intrastate Anti-Drug and Alcohol Misuse Prevention Self-Assessment Form.
4. The name and job title of the employees performing any work or functions covered by Part 199.

At the end of the calendar year, any Contractor whom performed work on the City of Duluth's Natural Gas system will also be required to submit a copy of their U.S. Department of Transportation Drug and Alcohol Testing MIS Data Collection Form. As a Contractor this information is required to be submitted with the City of Duluth's annual report to PHMSA.

S-8 OPERATOR QUALIFICATION FOR GAS WORK

This contract may require contractor personnel to perform covered tasks on the City of Duluth's natural gas system. To work on the natural gas system, the Contractor's personnel must be qualified to perform any of the covered tasks identified in the City of Duluth Operator Qualification Plan. Prior to the issuance of the Notice to Proceed, contractors, sub-contractors or vendors performing any of these covered tasks shall submit their Operator Qualification Plan and a list of employees' names, job titles and covered tasks to be performed under this contract to the Engineer for approval. The Contractor's Operator Qualifications for each employee should be cross referenced to the City of Duluth's Operator Qualifications requirements such that each course taken by the contractor's employee will identify the equivalent City of Duluth Operator Qualifications required course. The Operator Qualification Plan must be approved by the City before a Notice to Proceed will be issued.

S-9 CORRECTION PERIOD

The provisions of MN/DOT 1516 Acceptance are supplemented with the following:

If within one year after the effective date of Project Acceptance as specified in MN/DOT 1516.2 (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner is found to be defective, the Contractor shall promptly, without cost to Owner and in accordance with written instructions:

- A. Repair such defective land or areas; or
- B. Correct such defective work; or
- C. If the defective work has been rejected by owner, remove it from the project and replace it with work that is not defective, and
- D. Satisfactorily correct or repair or remove and replace any damage to other work, to the work of others or other land or areas resulting there from.

S-10 MEETINGS

A Preconstruction Meeting will be scheduled and conducted by the Engineer and shall be attended by representatives of the Owner, Contractor and all subcontractors as deemed required by the Engineer. The purpose of the meeting will be to identify all project participants, review

project requirements and specifications, establish the method of making pay requests and other matters that may be deemed necessary to be discussed. At this meeting, the Contractor shall submit the proposed construction schedule for review, consensus by the parties and approval. The Contractor shall also submit a schedule of values for the work to be used as the accounting format for all progress payments.

Brief weekly Construction Progress meetings, as deemed necessary by the Engineer, will be held and shall be attended by all Contractors. The purpose of the meeting will be to coordinate work schedules, review the project progress and other matters that may be deemed necessary to be discussed. A construction progress meeting agenda shall be prepared as deemed necessary by the Engineer. All construction progress meeting attendees shall be fully prepared prior to the meeting and shall be ready to discuss issues raised as they relate to their work. This shall include, but not be limited to, providing revised schedules, milestone activities, specific requirements for subordinate construction and any proposed or completed changes required for their work.

S-11 PROJECT LABOR AGREEMENT

In accordance with Duluth City Code, Chapter 2, Article IV, Section 2-29, a Project Labor Agreement will be required for projects of \$150,000 or greater. The Contractor and all direct subcontractors of the Contractor--of whatever tier--who have been awarded contracts for this Project shall accept and be bound by the terms and conditions of the Project Labor Agreement. The Contractor shall be signatory to the Project Labor Agreement; a copy of which, in its substantial form, is included in Appendix C of this specification.

S-12 GOVERNING SPECIFICATIONS

- A. The 2018 Edition of the Minnesota Department of Transportation 'Standard Specifications for Construction' shall govern.
- B. Latest version of Minnesota MUTCD, including the latest version of the Temporary Traffic Control Zone Layouts field manual.
- C. Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe, (Most current version). All references to Department mean the City of Duluth.

S-13 DAMAGE TO CITY UTILITIES

Section 48-224 through Section 48-228 of the Duluth City Code allows for the City to collect damages and penalties from any person that damages a City owned utility (water, sanitary sewer, storm sewer and natural gas) during excavation activities. In addition, the City may refuse to issue excavation permits or may reject bids from any contractor found to have violated this ordinance more than twice within the preceding twelve months.

Minnesota Statutes 216D.06 Damage to Facility also specifies that any excavator who knowingly damages an underground facility, and who does not notify the City as soon as reasonably possible or who backfills the excavation is guilty of a misdemeanor. It also states that it is prima facie evidence of the excavator's negligence in a civil court action if damage to the underground facilities of the City resulted from excavation, and the excavator failed to give an excavation notice under the Gopher State One Call rules.

The City of Duluth will act on all cases where an excavator violates City Code or State Statutes in the course of excavating.

S-14 RESPONSIBLE CONTRACTOR

SP2018-6

The Department cannot award a construction contract in excess of \$50,000 unless the bidder is a "responsible contractor" as defined in Minnesota Statutes §16C.285, subdivision 3.

A bidder must verify it meets the minimum criteria detailed in the law. A bidder must submit its verification electronically by completing the "Responsible Contractor" section in the "Officers and Acknowledgements" Folder within the Electronic Bid File. A company officer must certify statements in that section. Bidders only need to complete the electronic verification; DO NOT email, fax, or send paper forms to the Department. The Department will not accept emailed, faxed or other paper submissions and will only accept electronic verifications.

A bidder must obtain a verification from each subcontractor it will have a direct contractual relationship with. At the Department's request, a bidder must submit signed subcontractor verifications. A contractor or subcontractor must obtain an annual verification from each motor carrier it has a direct contractual relationship with. A motor carrier must give immediate written notice if it no longer meets the minimum responsible contractor criteria. The requirement for subcontractor verifications does not apply to:

- Design professionals licensed under Minnesota Statutes §326.06; and
- A business or person that supplies materials, equipment, or supplies to a subcontractor on the Project, including performing delivering and unloading services in connection with the supply of materials, equipment, and supplies. But, a business or person must submit a verification if it delivers mineral aggregate such as sand, gravel, or stone that will be incorporated into the Work by depositing the material substantially in place, directly or through spreaders, from the transporting vehicle.

A bidder or subcontractor who does not meet the minimum criteria specified in the statute, or who fails to verify compliance with the criteria, is not a "responsible contractor" and is ineligible to be awarded the Contract for this Project or to work on this Project. Submitting a false verification makes the bidder or subcontractor ineligible to be awarded a construction contract for this Project. Additionally, submitting a false statement may lead to contract termination. If only one bidder submits a bid, the Department may, but is not required to, award a contract even if that bidder does not meet the minimum criteria.

S-15 COMPLIANCE WITH TAX LAW REQUIREMENTS

SP2018-7

The Department cannot make final payment to the Contractor until the Contractor demonstrates that it and all its subcontractors have complied with the Income Tax withholding requirements of Minnesota Statutes, section 290.92 for wages paid for work performed under the contract. To establish compliance, the Contractor must submit a "Contractor Affidavit" either online or in paper form (IC134) to the Minnesota Department of Revenue. The contractor will receive written certification of compliance when the Department of Revenue determines that all withholding tax returns have been filed and all withholding taxes attributable to the work performed on the contract have been paid. The Contractor must then provide this written certification to the Department to receive final payment.

Every subcontractor working on the Project must submit an approved "Contractor Affidavit" from the Minnesota Department of Revenue to the Contractor before the Contractor can file its own Contractor Affidavit. **The Contractor is advised to obtain the certification from each subcontractor as soon as the subcontractor completes work on the Project. Experience has shown that waiting until the project is complete to obtain the forms from all subcontractors is likely to result in significant additional work for the Contractor as it will be difficult or impossible to collect all forms.**

The Department of Revenue, in association with the Department of Employment and Economic Development, offers a free seminar to help contractors understand tax law requirements. The Department strongly urges the Contractor and all subcontractors to attend the "Employment Taxes & Employer Responsibilities Seminar" or similarly offered classes. You can find a schedule and more information on the Department's website at:

www.revenue.state.mn.us/businesses/withholding/Pages/EducationandOutreach.aspx.

Complying with this requirement is considered part of the Work under this contract. The Department will enforce this requirement equally with all other Contract requirements. Contractor delay in complying with this requirement will cause the Department to delay final payment and Contract Acceptance. The Department may also report non-compliance to the Department of Revenue, which may result in enforcement action by the Department of Revenue.

1103 DEFINITIONS

The provisions of MN/DOT 1103 are supplemented with the following:

SUBSTANTIAL COMPLETION. The time and date at which the Work has progressed to the point where, in the opinion of the Engineer, the Work is sufficiently complete, in accordance with the Contract Documents, so that the Work can be occupied and/or utilized for the purposes for which it is intended.

FINAL COMPLETION. The time and date at which, in the opinion of the Engineer, ALL of the Work is complete, in accordance with the Contract Documents, excluding turf maintenance and plant establishment activities.

UNIT DAY. 12:00 AM to 11:59 PM (0000-2359) or any portion thereof.

1302 AWARD OF CONTRACT

The provisions of MN/DOT 1302 are deleted and replaced with the following:

Within **60** calendar days after opening Proposals, the City will Award the Contract to the lowest responsible Bidder provided that the lowest responsible Bidder complies with the Proposal requirements. The City may also decide not to make a Contract Award. The City will notify the lowest responsible Bidder electronically, in writing, or by other means that the City has accepted the Proposal subject to execution and approval of the Contract as required by law.

The City and the lowest responsible Bidder may mutually agree to extend the time within which the City makes the Award.

For contract values greater than or equal to \$100,000, the award of Contract, if to be awarded, will be made by City Council Resolution to the lowest responsible bidder who complies with all prescribed requirements. The lowest responsible bidder will be notified of the Council meeting date, along with transmittal of the Contract and required forms.

For contract values less than \$100,000, the award of Contract, if to be awarded, will be made to the lowest responsible bidder who complies with all prescribed requirements. The lowest responsible bidder will be notified that their Proposal has been accepted, along with transmittal of the Contract and required forms.

As a condition precedent to approval of a Contract, a sworn statement shall be filed with the City stating that the persons, firm, association, or corporation to whom the Contract is awarded has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the Contract. This sworn statement shall be in the form of an affidavit executed by, or on behalf of, the successful bidder and sworn to by him before a person who is authorized by the laws of this State to administer oaths. The forms for this affidavit will be furnished to the successful bidder and they shall be properly executed and returned within the period prescribed.

1305 REQUIREMENT OF CONTRACT BOND

The provisions of MN/DOT 1305 are supplemented with the following:

At the time of the execution of the Contract, the successful bidder shall furnish "Performance Bond" and a "Payment Bond" on City of Duluth forms. Both bonds shall be in amounts equal to the full amount of the contract price.

1306 EXECUTION AND APPROVAL OF CONTRACT

The provisions of MN/DOT 1306 are supplemented with the following:

The Contract shall be signed by the lowest responsible bidder and returned, together with the Performance Bond and the Payment Bond, non-collusion affidavit, EEO affidavit, and Proof of Insurance, within ten (10) calendar days after the date of Council Award, or the date of Proposal acceptance, subject to execution and approval of the Contract as required by law.

A "Notice to Proceed" letter will be issued after the Contract and Bonds are fully executed.

Contract Time shall start on the date of Notice to Proceed, or on the start date specified in the project Special Provisions, whichever is earlier.

If return of the executed forms within the specified time is impossible due to the absence of one or more of the required signers, an extension of time may be granted by the City, provided that satisfactory evidence is furnished that the forms will be executed.

All members of a partnership, and the President or Vice President and the Secretary or Treasurer of each corporation shall sign the Contract and Bonds. In the case of joint ventures, signature requirements shall apply to each firm represented.

1404 MAINTENANCE OF TRAFFIC AND LOCAL ROAD CLOSURE NOTIFICATIONS

The provisions of MN/DOT 1404 are supplemented with the following:

- (A) Refer to Section 2563 of these provisions for Temporary Traffic Management.
- (B) The Contractor shall notify ALL local stakeholders of road closures with enough advance notice to allow a reasonable time to accommodate the traffic changes.

Road Closure Notifications:

- 911 Dispatcher
- Duluth Fire Department 730-4400
- Duluth Police Department 730-5400
- Duluth Engineering (*front desk*) 730-5200
- Duluth Transit Authority (DTA) (*only when it affects a bus route*)
 - Rod Fournier 623-4336
or by email at: rfournier@duluthtransit.com
 - Dispatchers (*only if very short notice*) 623-4328
- District School Buses – (Notify ALL three contacts)
 - Steve Johnson (ISD709 *Trans Mgmt*) 336-8700 Ext. 4005
 - Dale Honkala (ISD709*Trans Mgmt*) 348-5879
 - Voyager Bus Company (Rudy, Josh or Deb).....724-1707
- St. Louis County Communications Supervisor
 - Emily Warnygora.....336-4349
- Summit Shuttle (only UMD/St. Scholastica/Rice Lake Rd./W. Arrowhead Rd.)
 - Jeff Richtman 651-705-3313 or 651-373-6137 (c)

1502 PLANS AND WORKING DRAWINGS (SHOP DRAWINGS)

MN/DOT 1502 is supplemented with following:

The contractor shall submit shop drawings for products supplied on the project. 'Shop drawings' shall include any product literature that identifies the materials, performance, manufacturer, type, size, and model number of products to be supplied. The list of required shop drawings will be reviewed and confirmed at the pre-construction meeting. The Contractor shall review all shop drawings for compliance with the contract documents. The Contractor shall "mark-up" shop drawings with pertinent notations to clarify the work furnished and identify any deviations. The Contractor shall include a signed certification that indicates the shop drawings are "reviewed" and all deviations shall have the reviewers "initials and date" and City standard noted on the page. The Contractor shall submit the shop drawings to the Engineer with sufficient time (not less than 14 days) to allow review and comment of the submittal.

The Engineer will review the shop drawings for compliance with the contract documents and current City standards. The Engineer will respond with comments (within 14 days of receipt of submittal) to the Contractor that the items submitted are either "reviewed" or "resubmit". The Engineer may consider work unacceptable and no payment will be made, if the shop drawing review is not completed for products incorporated into the work.

In addition, the Engineer will submit "reviewed" shop drawings for **all HDPE water main and fittings** to the Chief Engineer of Utilities for review. The Engineer and Contractor will schedule a time to meet on the construction site with the Chief Engineer of Utilities to inspect the materials furnished prior to use in the work. No HDPE water main work will be considered acceptable and no payment will be made without the completed shop drawing review and inspection of the Chief Engineer of Utilities.

1504 COORDINATION OF CONTRACT DOCUMENTS

The first paragraph of MN/DOT 1504 is deleted and replaced with the following:

A requirement appearing in one of the Contract documents is as binding as though the requirement appears in all. If discrepancies exist between the Contract documents, the following order of precedence applies:

- (1) Addenda,
- (2) Special Provisions,
- (3) Project-Specific Plan Sheets,
- (4) City of Duluth Standard Construction Details,
- (5) City of Duluth Standard Construction Specifications,
- (6) MN/DOT Supplemental Specifications,
- (7) MN/DOT Standard Plan Sheets and Standard Plates,
- (8) MN/DOT Standard Specifications.

1507 UTILITY PROPERTY AND SERVICE

Construction operations in the proximity of utility properties shall be performed in accordance with the provisions of MN/DOT 1507, except as modified below:

- A. Bidders are advised that the following utility companies have existing facilities in the construction area that may be affected by the work under this Contract.

WATER, GAS, STORM and SANITARY SEWER

City of Duluth--Public Works & Utilities
411 West 1st Street
Duluth, MN 55802
(218) 730-4130

GAS (in Bayview Heights)

Minnesota Energy Resources Corp
910 Cloquet Ave
Cloquet, MN 55720
(800) 889-9508

POWER

Minnesota Power
30 West Superior St
Duluth, MN 55802
(218) 722-2641

SANITARY INTERCEPTOR SEWERS

Western Lake Superior Sanitary District
2626 Courtland St
Duluth, MN 55806
(218) 722-3336

STREET LIGHTS & TRAFFIC SIGNALS

City of Duluth - Traffic Operations
1532 West Michigan St.
Duluth, MN 55806
(218) 730-4420

TELEPHONE

CenturyLink
322 West 1st Street
Duluth, MN 55802
(218) 723-4210 (Manager)

STEAM

Ever-Green Energy, LLC
One Lake Place Drive
Duluth, MN 55802
(218) 723-3601

CABLE TELEVISION

Charter Communications
602 Garfield Ave
Duluth, MN 55802
(218) 529-8000

- B. The City's Contractor shall coordinate their work and cooperate with the foregoing utility owners and their forces in a manner consistent with the provisions of MN/DOT 1507 and the applicable provisions of MN/DOT 1505.
- C. The Contractor shall perform work in a manner that all existing utility valves, manholes, pull boxes, controls, access vaults, pedestals, and poles are accessible to the utility operator. Materials or equipment will not be allowed to be stored over, or impede access to, the facility.

1508 CONSTRUCTION STAKES, LINES AND GRADES

The provisions of MN/DOT 1508 are supplemented to include the following:

The primary line and grade for utility installation will be established by the Engineer. For trench installation, line and grade stakes will be set parallel to the proposed pipeline at an appropriate offset as will best serve the Contractor's operations wherever practical. For tunnel or directional drilling installation, line and grade stakes will be set directly above the proposed pipeline setting. Grade and stakes will be set at appropriate intervals along the pipeline and at appurtenances and service lines.

For sanitary or storm sewer installation, the Contractor shall use a "laser beam" instrument to maintain line and grade.

The Contractor shall arrange his operations as will avoid necessary interference with the establishment of the primary line and grade stakes and shall render whatever assistance may be required by the Engineer in accomplishing the staking. The Contractor shall provide a minimum of 2 working day notice for all staking requests. The Contractor shall be responsible for preservation of the primary stakes and shall bear the full cost of any re-staking necessitated by his negligence. The Contractor shall be solely responsible for the correct transfer of the primary line and grade to all working points and for construction of the work to the prescribed lines and grades as established by the Engineer.

1511 INSPECTION OF WORK – ACCESS TO WORK FOR RECORD SURVEY

The provisions of MN/DOT 1511 are supplemented to include the following:

The Contractor shall provide access to all work for the purpose of inspection and record survey documentation. Access routes to, and including the open excavations, shall meet all OSHA safety requirements.

1604 PLANT INSPECTION – COMMERCIAL FACILITY

The provisions of MN/DOT 1604 are supplemented as follows:

All costs of shop inspection at plants outside the United States shall be borne by the Contractor. Such costs shall be deducted from monies due or to become due the Contractor.

1701 LAWS TO BE OBSERVED (PROMPT PAY AND RETAINAGE)

SP2018-33: The provisions of MN/DOT 1701 are supplemented with the following:

Prompt payment of subcontractors is required by Minnesota Statutes §16A.1245.

The Contractor must pay a subcontractor within ten days of receiving payment from the Department for undisputed work provided by that subcontractor. If the Contractor fails to pay a subcontractor on time, then the Contractor must pay interest, at the rate of 1.5% per month, to the subcontractor on the undisputed amount not paid on time. For an unpaid amount under \$100, the Contractor must pay the actual interest penalty (calculated at 1.5% per month). For an unpaid amount over \$100, the Contractor must pay the actual interest penalty (calculated at 1.5% per month) or \$10, whichever is greater.

Minnesota Statutes §16A.1245 also provides that a subcontractor who prevails in a civil action to collect interest penalties from a prime contractor must be awarded its costs and disbursements, including attorney's fees, incurred in bringing the action.

Withholding of retainage is limited by Minnesota Statutes §337.10.

The contractor may not withhold more than 5% in retainage from a subcontractor, as provided by Minnesota Statutes §337.10 subd. 4 (b).

State law does not require retainage to be withheld.

1701 LAWS TO BE OBSERVED (WETLANDS)

SP2018-34: The provisions of MN/DOT 1701 are supplemented with the following:

If the Contractor operations involve the excavation and/or disposal of material outside the limits of the project site, the Contractor is advised of the following:

MN Statutes Sections 103G.2212 and 103G.241 stipulate that an agent or employee of another may not:

- 1) drain, excavate, or fill a wetland, wholly or partially; or
- 2) construct, reconstruct, remove, or make any change in any reservoir, dam, or the course, current, or cross-section of any public water;

UNLESS a signed statement from the property owner is obtained stating that any permit or wetland replacement plan required for the work is in place, or that a permit or replacement plan is not required; **AND** this statement is mailed to the appropriate office with jurisdiction over the wetland or public water prior to initiating the work.

The "Landowner Statement and Contractor Responsibility For Work in Wetlands or Public Waters" can be found at:

http://www.bwsr.state.mn.us/wetlands/forms/Contractor_Responsibility.doc .

The Contractor shall provide the Engineer with a copy of the completed "Landowner Statement and Contractor Responsibility for Work in Wetlands or Public Waters" for the excavation and/or disposal site prior to initiating the work.

1706 EMPLOYEE HEALTH AND WELFARE

SP2018-41: The provisions of MN/DOT 1706 are supplemented with the following:

1. The Contractor must not use motor vehicle equipment that has an obstructed rear view unless:
 - (A) The vehicle has a reverse alarm that is audible above the surrounding noise level; or
 - (B) An observer signals to the operator that it is safe to reverse.

2. **The Department may assess a monetary deduction \$500 per incident for a violation of**

safety standards that could result in death or serious injury.

3. The areas of special concern include, but are not limited to, excavation stability protection, fall protection, protection from overhead hazards, vehicle backup protection, confined space safety, blasting operations, and personal safety devices.
4. The Contractor cannot avoid complying with safety standards by paying the deduction.

1717 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT

Revised 01/25/19

SP2018-45 modified:

The Contractor must prevent, control, and abate the pollution of natural resources of air, land and water caused by the Contractor's operations under this Contract in accordance with the rules, regulations, and standards adopted and established by the Minnesota Pollution Control Agency (M.P.C.A.), and in accordance with this Contract, , including the following:

1. By signing the NPDES Declaration and completing the electronic online NPDES CSW permit, the Contractor is a co-permittee with the Department and must ensure compliance with the terms and conditions of the Construction Stormwater General Permit (MN R100001). The Contractor is responsible for those portions of the permit referencing the "operator". This Permit establishes conditions for discharging storm water to waters of the State from construction activities that disturb 1 acre or more of total land area. A copy of the permit is available at <http://www.pca.state.mn.us/water/stormwater/stormwater-c.html> or by calling 651-296-6300.

- (A) Unless otherwise noted in the project special provisions, the **Contractor shall apply and pay for the MPCA/NPDES permit application** on this Project. Payment for the permit application shall be incidental to the Contract. The Department will provide the Contractor with the information needed for Sections 1 thru 3 and 5 thru 14 of the application form, as part of the Contract document package. The Contractor shall complete the application process, and post the Permit Coverage Card and MPCA's letter of coverage on the construction site with the Storm Water Pollution Prevention Plan (SWPPP). A copy of the MPCA/NPDES permit coverage confirmation must be returned to the Engineer.

No work that disturbs soil and/or work in waters of the state is allowed on this Project until the MPCA/NPDES Permit is in effect and the Department has received the required documentation.

2. Contractor must provide an Erosion Control Supervisor as per MN/DOT 2573.3. The Contractor is solely responsible for all inspections, maintenance, and records required in the General Permit, Section 11. Contractor must use standard forms for logging all required inspection and maintenance activities. Contractor must submit all inspection and maintenance forms used on this Project to the Engineer weekly for retention in accordance with the permit. The Contractor must also have the forms available for on-site review.

Contractor must immediately notify the Engineer of any site visits by Local Permitting Authorities performed in accordance with Section 24.10 of the permit. The Contractor must obtain the Engineer's approval before starting any work required by regulatory authorities which (1) the

Contractor believes will result in additional compensation from MN/DOT; or (2) will impact the design or requirements of the Contract documents or impact traffic.

The Contractor must use Emergency Best Management Practices to help minimize turbidity of surface waters and relieve runoff from extreme weather events. The Contractor must report a stormwater sediment release from the project site to the Minnesota Duty Officer and the Resident Engineer at the time the Contractor or Department discovers the release. The Contractor must also immediately contact the State Duty Officer (at 1-800-422-0798 or 1-651-649-5451) during any emergency situation involving an uncontrolled stormwater release.

Contractor must Review and abide by the instructions contained in the permit package. The Contractor will indemnify and hold MN/DOT harmless for any fines or sanctions imposed by a regulatory authority and arising from the Contractor's acts or omissions in complying, or failing to comply, with the permit or erosion control provisions of this Contract.

The NPDES Permit refers to a Storm Water Pollution Prevention Plan (SWPPP). This Project's SWPPP requirement is addressed throughout the Contract, as well as this Project's Plan. The following table identifies NPDES permit requirements and cross-references where this Contract addresses each requirement. This table is for ease of reference only and may be incomplete.

NPDES Permit Requirements	Cross-Reference within this Contract
Obtain NPDES Permit; Permit Compliance; Submit Notice of Termination	MnDOT 1701, 1702; and 1717 Special Provisions: 1717 (National Pollutant Discharge Elimination System (NPDES) Permit)
Certified Personnel in Erosion / Sediment Control Site Management Develop a Chain of Command	MnDOT 1506, 1717, and 2573; Special Provisions: 1717 (National Pollutant Discharge Elimination System (NPDES) Permit)
Certified Personnel in Erosion / Sediment Control Site installation	MnDOT Specifications 2573
Project / Weekly Schedule (for Erosion / Sediment Control) Completing Inspection / Maintenance Log / Records	MnDOT 1717 and 2573; Special Provisions: 1717 (National Pollutant Discharge Elimination System (NPDES) Permit); and
Project Specific Construction Staging	The Plans; MnDOT 1717; Special Provisions: 1717 (National Pollutant Discharge Elimination System (NPDES) Permit); and 1806 (Determination and Extension of Contract Time)
Temporary Erosion / Sediment Control	The Plans; MnDOT 2573, 2574 and 2575
Maintenance of Devices / Sediment removal Removal of Tracked Sediment Removal of Devices	The Plans; MnDOT 1717.2 and 2573.3K, 2573.3.R.; Special Provisions: 1514 (Maintenance During Construction), and 1717 (National Pollutant Discharge Elimination System (NPDES) Permit)
Dewatering	MnDOT 2573.3.A.6, 3875; May also require DNR Permit
Temporary work not shown in the Plans	MnDOT 1717, 2573, 2574 and 2575;

NPDES Permit Requirements	Cross-Reference within this Contract
Grading areas (unfinished acres exposed to erosion)	Special Provisions: 1717 (National Pollutant Discharge Elimination System (NPDES) Permit), 2574.3.A.1
Permanent Erosion / Sediment Control and Turf Establishment	The Plans; MnDOT 1717, 2573, 2574, and 2575; Special Provisions: 1717 (National Pollutant Discharge Elimination System (NPDES) Permit)

1717 EROSION AND SEDIMENT CONTROL PERMIT FOR MS4 COMPLIANCE

The provisions of MN/DOT 1717 are supplemented with the following:

For projects with a land disturbance greater than 3,000 square feet, the pollution of natural resources of air, land and water by operations under this Contract shall be prevented, controlled, and abated in accordance with the rules, regulations, and standards adopted in the Unified Development Chapter of the City of Duluth Legislative Code and in compliance with the Minnesota Pollution Control Agency (M.P.C.A.) Municipal Separate Storm Sewer System (MS4) general permit MNR040000 , these Special Provisions, and the following:

1. The Contractor shall obtain an Erosion and Sediment Control Permit (ESCP) for ALL projects with a land disturbance area **greater than 3,000 square feet and less than 1.0 acre.**
2. The Contractor shall obtain **BOTH** the Erosion and Sediment Control Permit (ESCP), and the MPCA/NPDES Permit (described above) for ALL projects with a land disturbance area **greater than or equal to 1.0 acre.**
- 3.
4. The Erosion and Sediment Control Permit application form can be picked up at the City's Construction Services & Inspections Office, Room 210, City Hall, or downloaded from the City's web site as follows:

<http://www.duluthmn.gov/construction-services-inspections/permits/>

4. For City public improvement projects, the City's project manager will coordinate the internal application review and processing of the ESCP application.
5. In accordance with goals of the City MS4 program, the Contractor shall use street sweeping to remove sediment on streets resulting from vehicle tracking or haul vehicle spillage. Equipment shall be pick-up type sweeper having adequate water and spray dust controls to meet all air quality regulations and avoid creating a nuisance to adjacent properties. All street sweeping required under this Contract shall be performed as incidental work.
6. In addition to the requirements of the project SWPPP incorporated into the ESCP, the Contractor shall incorporate the MPCA guidance and recommendations into their site management activities. Refer to the MPCA's web site:

<http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/construction-stormwater/index.html>

1717 AIR, LAND, AND WATER POLLUTION (CONCRETE GRINDING)

Revised 10/20/17

SP2018-44 modified: The provisions of MN/DOT 1717 are supplemented and/or modified with the following:

1. Concrete Diamond Grinding Operations and Slurry Management

The Contractor must not permit residue and water to flow across adjacent traffic lanes, flow onto shoulder, flow off bridge decks, flow into gutters, or flow onto private property. The Contractor shall provide a plan for both the on-site and off-site slurry management. The Contractor shall choose, and the Engineer will approve, the methods for slurry management in accordance with the following provisions.

Slurry Management is prohibited within federally recognized tribal land boundaries.

2. Areas of Environmental Sensitivity

On-site slurry management is prohibited within Areas of Environmental Sensitivity (AES). These areas will require off-site slurry management. No slurry discharge is allowed in the AES or within the buffers (see table 1717-1) to an AES. Identification of the AES are as follows:

- (1) MnDNR Public Waters Inventory (PWI).
- (2) National Wetland Inventory (NWI).
- (3) Calcareous fens.
- (4) Permanent vegetation designated for preservation, such as areas adjacent to the right of way identified as a 'Site of Biodiversity Significance' or 'Native Plant Community' by the DNR Minnesota Biological Survey (MBS).
- (5) Prairie remnants, including but not limited to areas adjacent to Railroad Rights-of-way Prairies.
- (6) Wooded areas with specimen trees.
- (7) Locations with Federal or State listed Threatened or Endangered plant species.
- (8) Locations with Federal or State listed Threatened or Endangered aquatic species.
- (9) Historic properties.

Identification of items 1- 5 are found on the following web link: <https://gisdata.mn.gov/>.

Identification of items 6-9 are provided by the Office of Environmental Stewardship (OES) staff through the project's Early Notification Memo (ENM) process.

The Engineer will identify all AES in the plans.

Other constraints within the project that must be addressed in the Slurry Management Plan and require slurry collection are as follows:

- (1) Roadways that utilize curb and gutter to convey storm water to catch basin inlets into a closed drainage system (storm sewers).

- (2) Inlet structures that utilize a piping system to convey storm water directly into stormwater treatment facilities or AES.
- (3) Bridge deck grinding.
- (4) Stormwater treatment ponds.
- (5) Infiltration/filtration basins.

3. Off-Site Slurry Management (when slurry is collected and taken to a containment basin or treatment facility)

Any areas identified in Section 2, along with other areas identified by the Engineer will require slurry collection in accordance with the following:

- (1) Collect and transport slurry in water-tight haul units to prevent spills.
- (2) Provide a temporary or permanent lined containment basin outside the right-of-way to decant the collected slurry.
- (3) Areas outside of the right-of-way may require a separate NPDES Construction Stormwater Permit as per Minnesota Pollution Control Association (MPCA).
- (4) Follow additional requirements in Section 5, Slurry Management Plan.

4. On-Site Slurry Management (when slurry is spread during the diamond grinding operation)

The Engineer will allow the Contractor to spread the slurry within MN/DOT right of way on the vegetated slope and median in accordance with the following requirements:

- (1) Maximum Buildup of Slurry Sediment
The Contractor shall spread the slurry at a rate to prevent sediment buildup of greater than 1/2 inch in any location by:
 - (a) Spreading the slurry either further up / down the slope with each subsequent pass of the grinder.
 - (b) Spread the material evenly on the adjacent slopes by using appropriate equipment (i.e., chain drags, tine harrows, plug aeration, dissipater plate, etc.) to break up the material.
 - (c) Remove and haul off site any sediment buildup of greater than 1/2 inch.
 - (d) Other spreading methods, as approved by the Engineer.
- (2) Vegetated Medians – The Engineer will allow slurry spreading within the entire roadway median in accordance with the following:
 - (a) Maintain a vegetated buffer zone (as per Table 1717-1) from any identifiable point of concentrated storm water flow. The following are examples of points of concentrated storm water flow in medians:
 - i. A transverse ditch bottom width of < 5 feet.
 - ii. Longitudinal scouring is apparent within median.
 - iii. An identifiable low point (V ditch) that runs parallel to the roadway.
 - (b) Do not spread slurry in areas identified for protection in accordance with Section 2.

- (c) Maintain the vegetated buffer zones as per Table 1717-1.
- (3) Vegetated Outside Slopes – Deposit the slurry on either the in-slope or back-slope and maintain the vegetated buffer zones outlined in Table 1717-1.
- (4) In order to minimize sediment infiltration into drainage systems, the Contractor shall:
 - (a) Only place slurry in locations that flow away from the roadway.
 - (b) Begin the slurry spreading operation a minimum of 1-foot from the paved shoulder.
 - (c) Provide compost filter log for inlet protection.
 - (d) Leave compost filter log in place after project is completed.

Table 1717-1 Buffer Zone / Areas Slurry Spreading is <u>NOT</u> Allowed	
Location	Vegetated Buffer Distance, ft
*Toe of in-slope or fill slope	5
*Toe of back-slope	5
Water level in roadside ditch or median ditch	5
Stormwater treatment ponds	100
Infiltration/filtration basins	100
Areas of Environmental Sensitivity	100
Stormwater inlet <u>without</u> inlet protection	100
Stormwater inlet <u>with</u> inlet protection	50
* Does not apply to median areas with a transverse ditch bottom width > 5 feet and standing water is not present.	

5. Slurry Management Plan

Prior to grinding operations, the Contractor shall submit to the Engineer in writing the proposed Slurry Management Plan for approval. Grinding operations shall not begin until the Plan is approved by the Engineer.

The Slurry Management Plan shall include the following:

- (1) When discharging on the slope, provide method to identify discharge start and stop locations for the equipment operator.
 Examples include:
 - (a) Lath and flagging tape
 - (b) Barrels
 - (c) The Engineer may approve other options as suggested by the Contractor.
- (2) When using a containment basin:
 - (a) Provide an estimate of the expected volume of slurry on the project and the volume of the containment basin.
 - (b) Ownership and location of the temporary containment basin.
 - (c) Method used to line the temporary containment basin. Examples include:

- i. Clay (including thickness of clay layer)
 - ii. Impermeable membrane (including thickness of membrane).
 - (d) Describe management of water. Examples include:
 - i. Allowing the water to evaporate,
 - ii. Re-using the water in the grinding operation, slurry broadcast operation, in a commercially useful manor (include engineering need, i.e., dust control, grade compaction),
 - iii. Water sent via sanitary sewer (provide proper permits)
 - iv. Hauling to a water treatment facility; (provide the name of the treating facility).
 - (e) Describe management of the solids (fines). Examples include:
 - i. Using the solids as a fill material, a component in recycled aggregate or any other commercially useful application (include engineering need),
 - ii. Solids transported to a reuse storage facility, MPCA permitted lined mixed municipal solid waste or industrial landfill. Furnish the Engineer with a document that identifies the name and location of the reuse storage facility or a MPCA permitted lined mixed municipal solid waste or industrial landfill.
 - (f) Describe restoration of the containment basin area. Include fill material, topsoil, seed mixtures and temporary covers.
- (3) pH control plan must include:
 - (a) Procedure used to maintain the pH of the slurry within the acceptable range,
 - (b) Example of pH test results log,

6. Control Of pH

Monitor and control the pH of the slurry for all operations to maintain a pH between 6 and 12.

- (1) Calibrate the test equipment prior to start-up of daily operations.
- (2) At the start-up of operations, test the pH at least once per hour to ensure it is within the acceptable limits.
- (3) Once the pH control plan is operational and producing consistent results, the testing frequency may be reduced to 4 tests per day.
- (4) Keep a signed and dated log of all pH test results for each piece of equipment collecting slurry and have available to the Engineer upon request.

7. Prior to Concrete Grinding Operations

The Engineer will schedule a pre-grinding meeting at the project site. The Engineer and Contractor will review the Slurry Management Plan for approval, including identification of the AES, acceptable slurry management practices, and any other aspects of the Plan as determined by the Engineer.

8. STOP WORK

Stop operations and perform the necessary corrective actions before proceeding when any of the following conditions occur:

- (1) Raining during operations resulting in discharge of slurry into buffer areas,
- (2) Equipment failing to contain or remove slurry,
- (3) Defined quality control requirements are not followed,
- (4) The slurry is discharged into areas not approved in the Slurry Management Plan,
- (5) The pH is outside the designated range,
- (6) The slurry discharges into waters of the state, or
- (7) A spill.

Notify the **State Duty Officer** immediately if condition (6) or (7) occurs.

1-800-442-0798

1801 SUBLETTING OF CONTRACT

Revised 10/20/17

SP2018-49: The provisions of MN/DOT 1801 are modified as follows:

For Projects in excess of \$50,000, the Contractor may sublet work only to subcontractors that meet the definition of "responsible contractor" in Minnesota Statutes §16C.285, subdivision 3. The Contractor shall obtain verifications of compliance with §16C.285 from subcontractors using a form provided by the Department. The Contractor must provide such verifications to the Department upon the Department's request.

The third paragraph of MN/DOT 1801 is modified to read:

On Contracts with Disadvantaged Business Enterprise (DBE), Targeted Group Business (TGB) or Veteran-Owned Small Business (VET) established goals, or any combination thereof, the Contractor's organization shall perform Work amounting to not less than 30 percent of the total original Contract Amount. The Department will deduct specialty items from the total original Contract Amount before calculating the amount of Work that the Contractor shall perform.

1803 PROGRESS SCHEDULES

The provisions of MN/DOT 1803 are supplemented as follows:

A "Progress Schedule" (Bar Chart or Critical Path Diagram), referred to in MN/DOT 1803.1 will be required on this Project. The Contractor shall furnish the Engineer with the schedule at or before the preconstruction conference.

The Contractor shall notify the Engineer no later than 8:00 AM on Friday if they intend on working any part of the weekend.

1804 PROSECUTION OF WORK - LIMITATION OF OPERATIONS

The provisions of MN/DOT 1804.2 are supplemented as follows:

No work shall be performed during the period between 9:00 PM and 7:00 AM Central Standard Time unless specifically specified or authorized by the Engineer.

1804 PROSECUTION OF WORK (ADA)

Revised 10/25/18

SP2018-52: The provisions of MN/DOT 1804 are supplemented and/or modified with the following:

SPECIAL PROJECT ADA REQUIREMENTS

All pedestrian facilities on this Project must be constructed according to Public Rights-of-Way Accessibility Guidelines (PROWAG) which can be found at:

<http://www.dot.state.mn.us/ada/pdf/PROWAG.pdf>.

The appropriate pedestrian ramp details for each quadrant are included in the Plan. The Engineer may provide additional details to those provided in the Plan that meet the PROWAG guidelines as the need arises and field conditions dictate.

(A) The Contractor must designate a responsible person competent in all aspects of PROWAG to assess proposed sidewalk layouts at each site before work begins. The designated person must have attended the MN/DOT ADA Construction Certification Course and received a passing score, with in the past 3 years. For class dates and locations please refer to the following link at: <http://www.dot.state.mn.us/ada/training.html>. A minimum of one person per project must possess a valid ADA Construction Certification card anytime ADA work is being performed on the project. If work on electrical components is the only ADA work taking place on the project the electrician must have in their possession a current MN/DOT Signals and Lighting Certification.

ADA work shall include, but not be limited to, the following: assessment of proposed sidewalk layouts at each site before work begins, determining and marking removal limits for work pertaining to pedestrian facilities, all ADA related removals and grading, forming and finishing of concrete at all pedestrian facilities, paving pedestrian crossings, placing bituminous pedestrian facilities, final grading, and pavement markings. Any ADA work not listed above can be added at the discretion of the Engineer. An ADA Certified person is not required on site if the only work being performed concerns traffic signals and APS installations.

These requirements shall be effective as of May 1, 2019. Any time work the Contractor is performing concerns pedestrian facilities, the Contractor's ADA Certified person shall be on site.

(B) Pedestrian facilities must be constructed to meet the following criteria:

- (1) Pedestrian Access Routes (PAR) must be constructed to meet the following:
 - Minimum 4 feet width.
 - A maximum cross slope of 2.0%.
 - Vertical discontinuities must be less than 0.25 inches.
 - Must provide positive drainage without allowing any ponding and maintain existing drainage flow patterns unless indicated otherwise in the Plan.

- All grade breaks shall be constructed perpendicular to the path of travel.
- Maximum 5% running slope unless adjacent roadway profile exceeds 5%.

- (2) Landings are part of the PAR and must be constructed to meet the following:
- 4 feet by 4 feet minimum width and shall match full width of incoming PAR.
 - Maximum slope of 2.0% in all directions.
 - Required at all locations where the PAR changes directions or inverse running slopes are >2%.
 - Must be connected to the PAR.
 - Shall be constructed as a single plane surface having no grade breaks.
- (3) Ramps are part of the PAR and must be constructed to meet either of the following criteria:
- Longitudinal slopes less than 5% in the direction of travel requires no landing at the top of the ramp (unless the PAR changes direction).
 - Longitudinal slopes between 5 - 8.3% in the direction of travel require a landing at the top of the ramp.

(C) The Contractor and the Engineer shall work together to construct all pedestrian facilities set forth in the plans and in the above Section B.

If the plan or site conditions do not allow accessibility standards to be met, the Contractor shall consult with the Engineer to determine a resolution. The Engineer shall respond to the Contractor, in a timely manner (up to 24 hours), with a solution on how to proceed. The Contractor shall mitigate any potential delays by progressing other available work on the project.

If the Contractor constructs any pedestrian facilities that are not per Plan, do not meet the above requirements in Section B, or do not follow the agreed upon resolution with the Engineer, the Contractor will be responsible for correcting the deficient facilities with no compensation paid for the corrective work.

The following hold points will be utilized in the construction of pedestrian facilities.

- (1) **Removals** - The Contractor and the Engineer shall use the appropriate ramp, sidewalk, and driveway details in the Plan, and calculate the removal limits for the sidewalk and curb and gutter. If it is determined that the removal limits will exceed the plan removal limits by more than 10 feet and the plan removal limits are not adequate to meet PROWAG and MN/DOT Standards, the Contractor shall consult with the Engineer to determine a solution. Once the Engineer and the Contractor reach an agreement on how to proceed, the Contractor may finish the removals.
- (2A) **Curb and Gutter at Quadrants** – Prior to pouring the curb and gutter at curb ramps the Contractor and the Engineer must verify that the curb and gutter will work with any vertical constraints (doorways, steps, bus stops, outwalks and landing areas). Prior to pouring curb and gutter at quadrants the Contractor must

verify the zero height curb, and curb transitions will be located as shown in the Plans and will provide an adequate detectable edge as shown on Standard Plan 5-297.250 (Sheet 4 of 6). Verify curb tapers are constructed at correct heights so that positive boulevard slopes and drainage is maintained away from landings and sidewalks, to the newly constructed curb and gutter sections. The Contractor shall verify that the proposed gutter flow lines will provide positive drainage as well as maintain existing drainage patterns including existing gutter inflows/outflows. The curb and gutter shall be constructed as detailed in the Plan with a defined flow line and with no vertical discontinuities over $\frac{1}{4}$ ". For required flow line corrections including curb line raises and curb ramp cross slope "tabling", see Standard Plan 5-297.250 (Sheet 6 of 6). Curb shall be poured at 3% inflow around the radius or at a minimum distance of 10 feet from any zero height curb section when machine placed. The Contractor shall consult with the Engineer to determine a resolution if any of these conditions cannot be met. Once the Engineer and the Contractor reach an agreement on how to proceed, the Contractor may proceed with pouring the curb and gutter.

(2B) Curb and Gutter at Roadway Sections - Prior to pouring curb and gutter at roadway sections the Contractor must verify proposed curb and gutter heights will work with existing roadway and shoulder slopes. The Contractor shall verify prior to placing the pedestrian facilities that positive drainage is maintained within public Right-Of-Way (R/W), as well as maintaining existing off R/W drainage. The Contractor shall check to ensure all top back of curb elevations will allow for adequate boulevard slopes, PAR slopes, and widths as shown on Standard Plan 5-297.254 (Sheet 4 of 4) while maintaining all vertically constrained match points (doorways, steps, bus stops, outwalks and landing areas). The Contractor shall check all driveway locations and widths and follow driveway details and plans for all driveway layouts including curb heights and curb tapers. Driveway curbs sections and aprons shall be constructed to minimize changes in the sidewalk width, alignment, and profile. The Contractor shall consult with the Engineer to determine a resolution if any of these conditions cannot be met. Once the Engineer and the Contractor reach agreement on how to proceed, the Contractor may proceed with pouring the curb and gutter.

(3) Forming and Finishing - After the curb and gutter has been correctly poured, and the Contractor has set the sidewalk forms, the Contractor shall verify prior to placing the curb ramps and sidewalks that positive drainage is maintained within public R/W, as well as maintaining existing off R/W drainage, and that all the requirements in Section B will be achieved.

Ramps – In addition, the longitudinal slopes shown in the Construction Plans and the Standard Plan shall be utilized unless these conditions cannot be met. The starting point for setting the forms on the controlling ramp leg, landing, and sidewalk slopes should be the following:

Steep (S) = 7%
Flat (F) = 4%

Landing = 1%
Sidewalk Cross Slope = 1.5%

If any of these requirements cannot be met the Contractor shall meet with the Engineer to determine the best solution. Once the Engineer and the Contractor reach an agreement on how to proceed, the Contractor may proceed with the curb ramp and sidewalk pour.

Landings – An initial landing is the first required landing of a pedestrian ramp. All initial landings required at the top of a ramped sloped surface (>2% longitudinal slope), shall be formed and placed separately in an independent concrete pour. This does not include initial landings placed at roadway grade such as depressed corners, parallel ramps, rural flat landings, or flat cut-throughs. Secondary landings consist of all landings beyond the initial landing. These secondary landings do not require a separate landing pour.

Wet casting or drill and grouting of reinforcement bars will be required in accordance with the details shown in Standard Plan 5-297.250 (Sheet 6 of 6). Wet casting of reinforcement bars shall be installed through holes or slots in the forms, with a form height at least equal to the walk thickness of the formed concrete shown in the plans. These bars shall be deformed and installed with 2 inch minimum concrete cover.

When not accounted for in the Plan, payment for these bars will be made under Item 2301.602 (Drill & Grout Reinforcement Bar (Epoxy Coated) by the Each at the Predetermined Price of \$10.00 per bar furnished and installed. All necessary subgrade preparation and aggregate base placement for the entire ramp construction limit shall be done before the initial landing is constructed at each location.

(D) It shall be the responsibility of the Contractor, or Contractor's Surveyor if applicable, to lay out all proposed work at each intersection in accordance with the Plan and requirements listed in this Special Provision. The Contractor may confer with the Engineer for guidance in laying out the proposed work, but it will be the Contractor's responsibility to ensure the proposed work meets all the requirements of this Special Provision. This layout includes, but is not limited to placement of grade breaks, curb transitions, gutter flow lines, truncated dome placement, crosswalk marking placement, flares, landing limits, removal limits, driveway tie in limits, and ramp limits. It is important that the Contractor lay out this work properly to achieve the construction of a compliant pedestrian facility. The owner's surveyor will only stake points and elevations provided in the Plan. For custom designs, other than specific dimensions provided in the Plan, the Contractor shall be expected to scale dimensions from the Plan as needed to construct the facility. If scaled dimensions do not allow for a facility to be constructed to meet the requirements of this Special Provision, the Contractor shall follow the process listed in Section C. This layout work shall be incidental.

(E) The Contractor shall utilize measures and methods when working near existing buildings that will avoid damaging the building's face or structure. The contractor will be responsible for

any damage to the building's face or structure, both below and above ground. Any damage resulting from Contractor's operations will be repaired at the Contractor's expense to the satisfaction of the Engineer.

(F) The Contractor will round all joints and edges with a 1/4 inch radius grooving or edging tool within the PAR. This requirement includes all curb and gutter joints at zero inch height curb sections at curb ramps. Contraction joints shall extend to at least 30 percent of walk thickness. The Contractor shall also have the option of providing saw cuts to construct the sidewalk joints. If saw cutting, provide 1/8 inch wide contraction joints within the PAR, including all curb and gutter joints at zero inch height curb sections. When greater than 50 feet of continuous sidewalk runs are constructed the contractor shall saw cut all joints. This work shall be incidental.

The top grade break of walkable flares needs a visual joint to indicate a change in grade. To eliminate the use of excessive contraction joints in the quadrant the visual joint shall meet MN/DOT 2521.3.C, except the depth requirement is reduced to 1/4 inch.

In sections where concrete boulevard is placed between the back of curb and the sidewalk, the 1/2 inch preformed joint filler material shall be placed at the back of curb and between the outside edge of sidewalk at existing building or structures. The 1/2 inch wide preformed joint filler shall not be placed in the longitudinal joint between the sidewalk and boulevard, unless it is necessary to provide expansion at fixed structures. At locations where sidewalk is adjacent to existing buildings, extend walk up to the edge of building and place 1/2 inch preformed joint filler 1/2 inch lower than top of walk whenever possible. Furnish and install Backer Rod of appropriate diameter when joints are 1/4 inch wide or greater, clean surfaces and apply approved silicon joint filler to flush with top of walk. If the transverse sidewalk and boulevard joint layouts cannot be aligned, use approved preformed joint filler with a maximum 1/8 inch width and place between the sidewalk and boulevard to prevent contraction joints from migrating into the adjacent concrete panels.

(G) The minimum continuous and unobstructed clear width of a pedestrian access route shall be 4.0 feet. All new or reconstructed sidewalk widths shall match or exceed in place sidewalk and in no case shall it be less than 5.0 feet in width except at locations where obstructions cannot be moved or at driveways where slopes exceed the maximum allowable grades. The cross slope of the sidewalk or shared use path shall not exceed 2%, and shall be measured perpendicular to the path of travel across the entire surface width of the sidewalk or shared use path. Curb ramps should match proposed sidewalk PAR width and shall match full shared use path widths. Whenever possible, the entire landings should be placed in a single concrete placement. If this is not possible due to construction staging, follow requirements for reinforcement bar placement and tie adjacent landings together.

In areas where the sidewalk is to be constructed around fixed structures and the grade has been changed, the sidewalk shall be finished around these structures to the satisfaction of the Engineer at no additional cost.

Architectural elements such as brick pavers, concrete stamping, and multiple colored concrete placements shall be kept outside the curb ramps and landing areas. Any architectural elements that do not maintain a consistent flat smooth surface shall not be used within the PAR.

For jobs that have pedestrian signal system work.

(H) All pedestrian signal systems should be installed as shown in the Plan and must be constructed to meet the following criteria. The Contractor shall verify that the proposed push button locations will meet all of the following criteria before proceeding with the installation of the pedestrian push button system:

- Pedestrian push buttons shall be oriented with the button facing towards the intersection and the button face placed parallel to the outside edge of the crosswalk.
- Pedestrian push buttons shall be a minimum of 4 feet and a maximum of 10 feet from the back of curb/edge of roadway, but may be placed 1.5 feet to 4 feet from the back of curb/edge of roadway if mounted on a signal pole as indicated in the Plan or as approved by the Engineer.
- Pedestrian push buttons shall be located at the outside crosswalk edge and shall be no more than 5 feet offset from the projected outside edge of the crosswalk/detectable warnings.
- Pedestrian push buttons shall be a minimum of 10 feet apart, except in islands and medians where only a 6 foot clear distance must be maintained. This 6 foot obstruction free area is called a (MAR) Maintenance Access Route.
- The MAR is defined as a 6 foot minimum clear distance between any raised obstacles such as push button stations, electrical foundations (signal, lighting, or cabinet), buildings, V curb, utility poles, sign posts, etc.
This MAR is needed for mechanical removal of snow and ice. A maintenance access route is only required on the same route as the PAR. At quadrants, the MAR should be a paved surface but does not need to meet the PAR cross slope criteria.
- Each pedestrian push button shall have a landing immediately adjacent to the push button face with minimum dimensions of 4 feet by 4 feet and a maximum slope of 2.0% in all directions. Center the push button on the edge of landing if possible to do so without violating any of the requirements listed in this Special Provision. The landing must be connected to the Pedestrian Access Route.
- All new hand holes shall be placed outside of the PAR, inclusive of ramps and landings.
- The push buttons shall be mounted at a height of 42 inches as indicated in the Plan, and shall have a 10 inch maximum side reach. Every effort should be made to reduce the side reach distance to the least amount possible.
- Crosswalk pavement markings shall be striped in a straight alignment between the outside edges of the detectable warnings from the corner closest to the roadway edge. Markings shall be placed with no kinks unless the crosswalks are shown as kinked in the Plan.
- The Contractor shall maintain all working points marked by the surveyor and use the working points to lay out push button locations in accordance with the Plans and Special Provisions.

If any of these conditions cannot be met, the Contractor shall consult with the Engineer to determine a resolution per Section C. Once the Engineer and the Contractor reach an agreement on how to proceed, the Contractor may proceed. If the Contractor constructs any pedestrian push button systems or pedestrian facilities which do not meet the criteria or the

agreed upon resolution with the Engineer, the Contractor will be responsible for correcting the deficiencies with no compensation paid for the corrective work.

To help ensure signal systems are properly constructed the Contractor must adhere to the following practices:

- All push button station bases shall be installed using a breakaway pedestal base, see Typical APS Pedestrian Push Button Location and MN/DOT approved /qualified products list. The pedestal base shall be fastened to the station foundation using 4 5/8 inch (UNC) x 7 1/2 inch stainless steel anchor rods. The push button station foundation shall be constructed as part of the sidewalk by increasing the sidewalk dimension to a 12 inches minimum thickness and an 18 inches minimum diameter to top of sidewalk surface. The push button station foundation shall be placed as part of the landing. All construction joints/grade breaks shall be located outside of foundation area and designated landing area.
- When not accounted for in the Plan, and determined necessary by the Engineer payment to furnish and install additional APS pedestrian push button station will be \$1,000.00 each and will be made under Item 2565.602 (Pedestrian Push Button Station). Payment shall include all components necessary to furnish and install APS push button station, including additional conduit, wiring, APS push button base installation, and shaft with reflective tape and cap.
- Signal pole foundations which are being constructed in or adjacent to sidewalk shall be constructed in accordance with the applicable MN/DOT Standard Plate 8120 or 8126. If a push button is proposed to be mounted on a signal pole, a MN/DOT approved extension bracket shall be used. If a push button is proposed to be mounted on a signal pole, the APS push button shall meet the vertical, horizontal, and crosswalk skew requirements.
- All newly installed pedestal foundations when used as a push button station shall be constructed in accordance with applicable MN/DOT Standard Plate 8112. Concrete for new foundation shall be placed either with or after the landing concrete is placed, and the top of the foundation surface shall be 1/4 inch maximum higher than the top of the landing surface. If a push button is placed on a new or existing pedestal pole, the push button shall be installed using three APS push button spacers (Saddle Adaptors), and the APS push button shall meet the vertical, horizontal, and crosswalk skew requirements.

1807 FAILURE TO COMPLETE WORK ON TIME

The provisions of MN/DOT 1807 are supplemented as follows:

- A. The liquidated damages as set forth above may apply equally, separately, and may be assessed concurrently. These provisions shall apply in full to both the Substantial Completion Date and the Final Completion Date.

1906 PARTIAL PAYMENTS

Partial Payments shall be made in accordance with the provisions of MN/DOT 1906 and the following:

- A. The first sentence of Paragraph Three shall be amended to read as follows: "From the total of the amounts ascertained as payable, five percent (5%) will be deducted and retained by the City for the protection of its interests as hereinafter provided. The balance, less all previous payments, will be certified for payment." The City will withhold eight percent (8%) from out of state contractors unless a waiver has been granted from the State of Minnesota, Department of Revenue by submitting Form SDE, Exemption from Surety Deposits for Non-Minnesota Contractors.
- B. All provisions for partial payments shall apply to domestic materials only. No payments shall be made to the Contractor for materials manufactured outside of the United States until such materials have been delivered to the job site.

1908 FINAL PAYMENT

Final Payment shall be made in accordance with the provisions of MN/DOT 1908 and the following:

- 1) The final estimate will show the balance due the Contractor after making all legal and specified forfeitures and deductions. This balance will then be paid by the City to the Contractor within thirty (30) days after such estimate is presented to and accepted by the Contractor or within forty-five (45) days after such estimate is presented to and not acted upon by the Contractor, less five percent (5%) of the total value of work on the final estimate. At such time, the paid final estimate shall be considered valid with no further compensation due the Contractor.
- 2) The City will withhold and retain up to five percent (5%) of the final estimate for a period of up to one year after the effective date of Project Acceptance (MN/DOT 1516.2), or the date of Final Contract Acceptance (MN/DOT 1516.4), whichever is later.
- 3) Where the provisions of MN/DOT 2571.3.K Plant Establishment Period pertain to the contract, the City will withhold and retain an amount equal to the final value of planting bid items or one percent (1%) of the final estimate, whichever is greater, for a period of up to two calendar years after the initial planting operations are complete.
- 4) State Law provides that the final estimate will be made within 90 days after completion of all work required under this Contract. If, however, the total value of the Contract exceeds \$2,000,000.00, the 90-day requirement will not apply and the time allowed for making such final estimate shall be 180 days after the work under this Contract has been, in all things, completed to the satisfaction of the Commissioner
- 5) If this Contract contains a "Disadvantage Business Enterprise or Targeted Group Business" goal, the following requirement shall apply:

"Before final payment is made, the Contractor shall also complete an affidavit showing the total dollar amounts of work performed by disadvantaged business enterprise (DBE) and targeted group business (TGB) and/or veteran-owned small business."

2051 MAINTENANCE AND RESTORATION OF HAUL ROADS

Revised 01/08/16

The provisions of MN/DOT 2051 hereby deleted and replaced with the following:

A GENERAL

The Contractor shall take reasonable care to protect and maintain ALL haul routes.

B DESIGNATED HAUL ROUTE

1. In coordination with any traffic restrictions detailed in the Plans, the Contractor shall designate Haul Routes for approval by the Engineer. The Contractor shall submit Haul Route Application no later than 3 working days prior to the Preconstruction Conference.

A copy of Contractor's Haul Route Application form is available online at:

<http://www.duluthmn.gov/engineering/standard-construction-specifications/construction-documents/>

2. The Engineer will review the haul route application and approve either the proposed hauls routes or acceptable alternative haul routes. The intent of the Engineer's review is to keep the construction traffic on those streets that have adequate capacity to support the construction traffic, minimize traffic congestion, and minimize deterioration. The Engineer anticipates that the Haul Route(s) will be approved prior to the preconstruction conference.
3. Once the approved haul route has been established, the Contractor will be required to perform all hauling of equipment and supplies on those approved haul routes ONLY. The Contractor will not be allowed to haul on other streets without written approval of the Engineer to revise the haul route application. These haul route restrictions shall apply to all subcontractors and suppliers as well, for which the prime contractor shall be responsible to coordinate.

C RESTORATION OF HAUL ROADS

1. If, in the opinion of the Engineer, roadway deterioration occurs as a result of the construction traffic and repairs are needed on the streets **designated as "approved" haul routes**, the Engineer will direct the Contractor to make repairs. Repair work on the approved haul routes will be considered Extra Work and the Contractor will be compensated in accordance with the provisions of MN/DOT 1904.
2. If, in the opinion of the Engineer, roadway deterioration occurs as a result of the construction traffic and repairs are needed on City streets **not permitted or not designated as the approved haul routes**, it shall be a rebuttable presumption that said damage was caused by the Contractor impermissibly using such streets or roadways. The Engineer will direct the Contractor to make repairs to restore the road to a condition that is as good as, or better than, the road conditions existing prior to construction. Repair work on the non-approved routes will be considered incidental and no compensation will be made to the contractor. If the repairs are not made by the Contractor within 30 days, the Engineer may order the work done by others and deduct the cost from monies due the Contractor.

2101 CLEARING AND GRUBBING

Clearing and grubbing shall be performed in accordance with the provisions of MN/DOT 2101 and the following:

The City Forester has reviewed this project for possible plant material salvage. All transplanting will be done by City Maintenance forces prior to the Contract starting date. All remaining plant material necessary to be removed shall be removed and disposed of according to the Standard Specifications. Only those trees, branches, or brush necessary for proposed construction will be cut. Cutting trees, branches, or brush to clear additional area beyond proposed construction limits will not be permitted on this project.

2104 REMOVING PAVEMENT AND MISCELLANEOUS STRUCTURES

Abandoned structures and other obstructions shall be removed from the Right-of-Way and disposed of in accordance with the provisions of MN/DOT 2104, except as modified below:

- A. Measurement and payment for the removal and disposal of materials will be made only for those items of removal work specifically included for payment as such in the Proposal and as listed in the Contract Drawings. The removal of any unforeseen obstruction requiring, in the opinion of the Engineer, equipment or handling substantially different from that employed in excavation operations, will be paid for as Extra Work as provided in MN/DOT 1402.5.
- B. The Contractor shall maintain in place all existing "Stop" and "Yield" signs until the street is closed to traffic with barricades and "Road Closed" signs. The Contractor may remove and store, if necessary, "Stop" and "Yield" signs only when the street is closed to traffic. Before the street is re-opened to any traffic, the Contractor shall properly re-install the "Stop" and "Yield" signs.
- C. In 1998, the City of Duluth street name signs were replaced. The signs are in place to guide emergency vehicles, deliveries, and visitors. The signs need to remain visible at all times. If necessary to relocate, the new foundation shall be completed prior to removing pole and sign in order to conduct the relocation in one move. If a temporary relocation is necessary and approved, the sign must remain visible at all times and not touch the ground during the move. Any damage to the sign or any sign installation shall be replaced or repaired at the Contractor's expense.
- D. Drainage structure castings shall be removed and may be stockpiled on site. The Contractor shall coordinate and deliver the castings to the City of Duluth Sewer Division storage facility at 40th Avenue West. It shall be the Contractor's responsibility to unload the castings. Payment will be incidental to Item 2104.509 Remove Manhole or Catch Basin. Upon completion of the unloading, the castings will become the property of the City of Duluth.
- E. All materials removed during one working day that are scheduled for disposal shall be disposed of during the same working day. Job site stockpiling of removal items will not be permitted.

- F. Both the upgrade and downgrade ends of all drainage or sewer pipes leading from abandoned basements, manholes, or similar structures shall be plugged with concrete or masonry.
- G. Crushing or processing of pavement materials or rock on the project site shall not be permitted except as stated in the Special Provisions.
- H. Where not included in the Contract bid items, sawing of sidewalks, curbs, and pavements needed for removal shall be incidental.
- I. When removal of any existing abandoned cast iron gas main is required, the cut ends of the abandoned pipe to remain in-place shall be plugged with water-tight end cap or plug. Closed cell polyurethane foam sealant (Touch 'n Seal by Convenience Products, Polywater AFT by American Polywater Corporation, Spraytite 178 by BASF Corporation, or approved equal) will be considered an acceptable alternative to mechanical plugs, on a case-by-case basis, when authorized by the Engineer. In addition, a 1-inch PE or Type K copper "jumper" pipe shall be installed to connect the both cut ends to relieve accumulated water in the pipe. Plugs and jumper pipe shall be considered incidental and no direct payment will be made.

2104 REMOVE AND HAUL TREATED WOOD

Revised 12-08-17

SP2018-77: If the Contractor is required to dispose of treated wood, the provisions of MN/DOT 2104 are supplemented with the following:

The Contractor can elect to reuse the treated wood for its original intended purpose. The Contractor shall furnish a completed Transfer of Ownership form to the Engineer prior to removing any treated wood from the Project limits. The Transfer of Ownership form is available at the following website:

<http://www.dot.state.mn.us/environment/buildingbridge/index.html>.

If the Contractor cannot or elects not to re-use the treated wood for its original intended purpose, but must be disposed, the following shall apply:

(A) The Contractor shall dispose of all waste treated wood in a MPCA permitted Minnesota solid waste or industrial landfill or landfills listed under Landfills/Regulated Waste at:

<http://www.dot.state.mn.us/environment/buildingbridge/index.html>..

The Contractor shall not dispose of waste treated wood in a demolition landfill. Within 30 days after the treated wood is transported to the landfill, the Contractor shall provide the Engineer with shipping manifests, scale tickets and invoices. Shipping manifests shall include, but are not limited to, the following information: specify treated wood as the type of waste, quantity of wood, date of hauling and disposal, and location of disposal.

Measurement and payment for the removal and disposal of treated wood will be made only when specifically included for payment as such in the Proposal and as listed in the Plans. All other

removal and disposal of treated wood operations shall be incidental.

2105/2451 ROCK BLASTING AND VIBRATION CONTROL

The provisions for rock blasting, as covered herein, are applicable to all uses of explosive materials in the fragmentation of rock for the purpose of excavation of rock materials. These provisions cover the usage of explosives, project documentation, safety, public relations and vibration controls, required for the types of rock excavation listed below. Construction details for these items are found elsewhere in these specifications.

A. Definitions

1. (2105) Blast Monitor/Survey refers to preparatory work and operations for rock removal, including but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site, blasting plan submittal, maintaining appropriate records, safety, public relations, vibration control and monitoring, and insurance.
2. (2105) Controlled Excavation refers to the controlled use of explosives and blasting accessories in carefully space and aligned drill holes to produce a shear plane in the rock along the specified excavation back slope. Controlled excavation techniques covered by the specification include presplitting and cushion (trim) blasting.
3. (2105) Rock Excavation refers to the main fragmentation blasting resulting from appropriately spaced production holes drilled throughout the rock excavation area. This includes rock excavated outside the normal roadway grading section as defined under Rock Channel Excavation.
4. (2451) Structure Excavation, Class R refers to removal of rock materials (bedrock, boulders, detached rock) where the excavation will be used for the placement of bridges, retaining walls, water main, culverts, pipe sewers, drainage structures, subsurface drains, etc.

B. General Requirements

1. Use of Explosives

The regulatory requirements of OSHA Safety and Health Standards 29 CFR, Part 1926, Subpart U, "Blasting and Use of Explosives" shall apply. All blasting operations, including the storage and handling of explosives and blasting agents, shall be performed in accordance with the applicable provisions of the Standard Specifications and all other pertinent federal, state, and local regulations. Whenever explosives are used, they shall be of such character and in such amount as is permitted by state and local laws and ordinances and all respective agencies having jurisdiction over them. The person(s) responsible for the use of explosive materials shall be knowledgeable and experienced in their use and handling. Blasting will be limited to a period between 8:00 a.m. and 5:00 p.m. or as otherwise approved by the Engineer.

2. Blasting Plan Submittal

Not less than three weeks prior to commencing drilling and blasting operations or at any time the Contractor proposes to change the drilling and blasting methods, the Contractor shall submit a "Blasting Plan" to the Engineer for review. The blasting plan shall describe in full details, the drilling and blasting patterns the Contractor proposes to use for the types of blasting required by the Contract.

The **blasting plan** shall include (at a minimum):

- a. Name and experience of Blaster(s).
- b. Type of explosives, primers and initiators including manufacturers' data sheets for all explosive products.
- c. General blasting configurations including hole size, spacing, loading pattern, detonation procedure, anticipated maximum pounds of explosive per delay, powder factor, number of lifts, and limits of blasting.
- d. Procedures to inform and protect the public and adjacent property (e.g., signs, horns, letters, personal visits, etc.).
- e. Flyrock control plan.
- f. Proposed "Shot Log" for individual blasts.

The blasting plan submittal is for quality control and record keeping purposes. Review of the blast plan by the Engineer shall not relieve the Contractor of his responsibility for the accuracy and adequacy of the plan when implemented in the field. When the contract requires the Contractor to retain a blasting consultant to assist with the blast design, all blasting plan submittals must be approved by the blasting consultant.

3. Shot Log

The Contractor is required to submit records (shot logs) for each individual shot on forms approved by the Engineer. The shot log shall be maintained by the Contractor and submitted to the Engineer at the end of each day. No blasting will be allowed until the shot log from the preceding day has been submitted to the Engineer. The shot log shall include the following information (at a minimum);

- a. Location of the shot by station and offset.
- b. Plan view of the drill pattern including free face, burden, hole spacing, diameters and angles.
- c. Section view showing type and amount of explosives, primers, initiators, location and depth of stemming, lift height, and subdrill depth.
- d. Initiation sequence of holes including cumulative delay times and delay system.
- e. Maximum peak particle velocity measured at the closest (or most critical receptor), location of monitoring station, and scaled distance.

4. Scaling and Stabilization

All rock on the excavated face that is loose, hanging, or which creates a potentially dangerous situation shall be removed or stabilized to the Engineer's satisfaction during or upon completion of the excavation in each lift. Drilling of the next lift will not be allowed until this work has been completed.

Exposed rock slopes shall be scaled throughout the span of the Contract and at such frequency as required to remove all hazardous loose rock or overhangs. The slopes shall be hand scaled using a suitable standard steel mine scaling rod. Subject to the Engineer's approval, other methods such as machine scaling, hydraulic splitters, or light blasting may be used in lieu of or to supplement hand scaling. Payment for scaling and removal of scaled rock from outside the excavation limits shall be incidental to the Contract unit price for rock excavation.

If in-place stabilization of back slope rock is required due to defects inherent in the bedrock structure or weathering, as determined by the Engineer, rock bolting or other Engineer-approved stabilization techniques will be used and paid for as extra work. Stabilization necessitated, in the opinion of the Engineer, by the Contractor's blasting or excavation operations shall be performed at the Contractor's expense.

5. Safety

The Contractor shall observe the entire blast area for a minimum of five minutes following a blast to guard against rock fall before commencing work in the cut. The Contractor is responsible for the safety of workers and the public in general.

The Engineer will, at all times, have the authority to prohibit or halt the Contractor's blasting operations if it is apparent that, through the methods being employed, the required slopes are not being obtained in a stable condition or the safety, convenience, or property of the public is being jeopardized.

The Contractor is advised that structures may be located close to the proposed work and that noise and vibration producing activities shall be conducted so as to preclude damage to these structures and undue annoyance to their occupants. The Contractor shall be responsible for all damage caused by his activities.

6. Public Relations

The Contractor is required to have both letter and personal contact with residents or owners of buildings that are adjacent to the construction area or near enough to it for ground vibrations from construction operations (including blasting) to affect the structure, personal property, or water wells. This contact shall be made prior to the beginning of any blasting or other vibration producing activity. The Contractor shall furnish a list of those contacted to the Engineer, as part of the blasting plan.

The Contractor shall identify a contact person for complaints from the public and shall maintain a log of such complaints and any action taken by the Contractor. This log shall be available to the Engineer at his request. The Contractor shall make an initial reply to complaints within 24 hours.

C. Flyrock Control

Before the firing of any blast in areas where flying rock may result in personal injury or damage to property or the work, the rock to be blasted shall be covered with approved blasting mats, soil, or other equally serviceable material to prevent flyrock. Flyrock control procedures will be approved by the Engineer.

D. Fresh Concrete Vibration Controls

During the course of the work, the Contractor may desire to conduct vibration producing activities (such as blasting, vibratory compaction, pavement breaking or operation of heavy construction equipment) in the vicinity of freshly poured concrete. The following maximum* vibration levels for fresh concrete shall apply:

Concrete Age (hours)	Maximum Peak Particle Velocity [inches per second]
0-3	No Limit
3-12	1.00
12-24	1.50
24-48	2.50
48 or greater	4.00

(The term 'maximum' as used herein refers to the maximum of three mutually perpendicular transducer components.)

The Contractor shall provide the necessary monitoring equipment (typically a vibration seismograph) to assure that these limits are not exceeded. Any monitoring equipment supplied shall be capable of measuring a peak particle velocity of at least 4.0 inches per second. Vibrations shall be measured at a point directly between the concrete structure and the closest point of the vibration producing operation. The actual measuring point will be determined by the Engineer, and the geophone will typically be buried in the soil adjacent to the structure or placed on the structure. When located on the structure, the geophone must be grouted or mechanically fastened (bolted) to the structure.

If the Contractor desires to utilize higher vibration limits than those permitted above, he must submit a recommendation prepared by a recognized Consultant with expertise in this field. The Consultant report must be specific to this Project and shall include (at a minimum): 1) the proposed vibration limits, 2) basis for these limits, 3) specific equipment that will be employed to monitor the vibrations, and 4) potential impact of the proposed vibration levels on other structures or buildings on or off the Right of Way. The Engineer will review the submittal and respond within two weeks. If the use of higher vibration levels is approved and subsequent damage occurs, such as cracking of the concrete or deterioration of support rock below the structure, lower vibration levels will be established. Any damage caused by the higher limits shall be repaired by the Contractor to the satisfaction of the Engineer at no cost to the State.

The above vibration limits, or any new limits established for the protection of fresh concrete on this Project, do not relieve the Contractor from complying with any other vibration limits that may be in force on the Project, nor do they relieve the Contractor from responsibility for

damage to any existing structures (on or off the Right of Way) that may be affected by vibrations at lower levels than are allowed herein for the protection of the concrete.

The Engineer, at his discretion (or in consultation with the Geology Unit, Office of Construction Materials and Engineering), may waive the requirement for vibration monitoring if the vibration producing operation is conducted at such a distance that ground vibrations cannot be readily felt by a person standing adjacent to the location where the concrete will be poured.

E. Vibration Control and Monitoring

Whenever vibration damage to adjacent structures is possible, the Contractor shall monitor each blast with an approved seismograph located, as approved, between the blast area and the closest (or most critical) structure subject to blast damage. The seismograph shall be capable of recording peak particle velocity for three mutually perpendicular components of vibration in the range generally found in construction blasting.

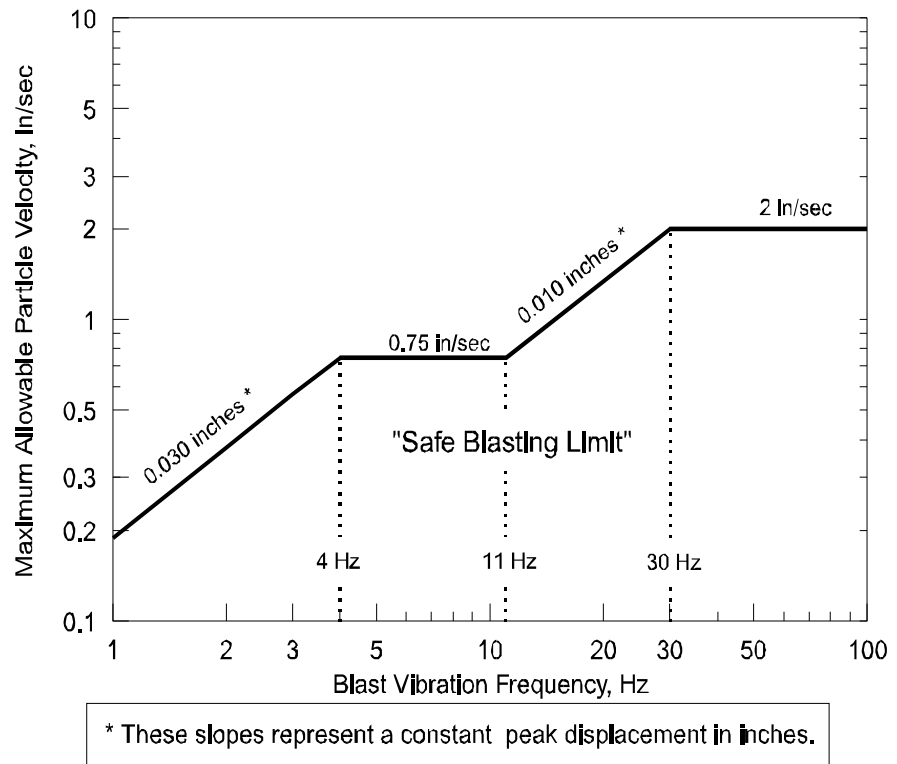
The peak particle velocity of each component shall not be allowed to exceed the safe limits, as established below, for all adjacent structures subject to vibration damage.

1. Ground Vibration Control Limit

The maximum single component peak particle velocity resulting from construction activity shall not exceed the safe blasting criteria established in the Office of Surface Mining recommendations, OSM Alternative Blasting Level Criteria (Modified from Figure B-1, RI 8507 U.S. Bureau of Mines). The criteria allow a constant peak particle velocity (ppv) of 2.0 inches per second (ips) above 30 Hz. Below 30 Hz, the maximum velocity decreases at a rate equivalent to a constant peak displacement of 0.01 inch to 11Hz. Between 11 Hz and 4 Hz, the maximum velocity is 0.75 ips. Below 4 Hz, the maximum velocity decreases at a rate equivalent to a constant peak displacement of 0.03 inch.

OSM Alternative Blasting Level Criteria

(Modified from Figure B1, RI 8507 U.S. Bureau of Mines)



2. Air Blast Control Limit

The maximum air blast resulting from blasting shall not exceed 135 dB (0.015 psi) Linear-Peak weighting. The A and C weighting systems are not allowed.

3. Vibration Monitors

An amplitude/frequency vibration monitor shall be supplied that is capable of measuring, recording, and producing a printed paper version of the frequency and peak particle velocity in each of three mutually perpendicular axes ("vector sum" instrumentation is not allowed). The instrument must have the appropriate sampling rate and velocity range to measure vibration levels generally found in construction blasting (must be able to measure peak particle velocity up to at least 4 inches per second). The instrument shall be capable of measuring Linear Scale air blast pressure (other weighting systems, such as A- or C-scale are not allowed). The instrument must also be capable of plotting the measured vibration level against the OSM criteria or be capable of reporting the frequency and displacement of each vibration event. The vibration monitoring equipment must have current calibration documentation. All vibration monitoring equipment shall be approved by the Engineer prior to usage on the Project.

When blasting near buildings, structures, or utilities which may be subject to damage from blast induced ground vibrations, the ground vibrations shall be controlled by the use of properly designed delay sequences and allowable charge weights per delay. Allowable charge weights per delay shall be based on vibration levels which will not cause damage. The allowable charge weights per delay shall be established by carrying out trial blasts and measuring vibration levels. The trial blasts shall be carried out in conformance with the blasting test sections described elsewhere in these provisions, modified as required to limit ground vibrations to a level which will not cause damage.

F. Measurement and Basis of Payment

Blast Monitor/Survey will be paid on a lump sum basis. On the first partial estimate that shows 10 percent or more of the original Contract amount of rock excavation has been earned, payment will be made under Item 2105.601 (Blast Monitor/Survey) for 50 percent of the amount bid. When the rock removal items are completed, the remaining 50 percent of the amount bid for Blast Monitor/Survey will be paid.

Payment for all work specified for monitoring vibrations in the vicinity of fresh concrete as described above, including but not limited to, furnishing monitoring equipment and maintaining appropriate records, shall be considered incidental.

2105 EXCAVATION AND EMBANKMENT

Revised 08/09/18

SP2018-92: The provisions of MN/DOT 2105 are modified as follows:

(1) MN/DOT 2105.1.A.6, "Select Grading Material," is deleted and replaced with the following:

A.6 Select Grading Material

Select grading materials are all mineral soils found in the Triaxial Chart in the Grading and Base Manual, excluding: organic soils per 2105.1.A.10, marl, and silt. Silt is defined as soils containing 80% or more silt-sized particles as determined by MN/DOT Laboratory manual procedure 1302. Select Grading Material may contain up to 100% recycled materials composed of recycled concrete, asphalt, or glass meeting the following:

- no more than 10% glass,
- no more than 75% concrete, and
- with a bitumen content of 3.5% or less.

(2) MN/DOT 2105.2.A.1, "Common Excavation," is deleted and replaced with the following:

A.1 Common Excavation

Excavation not classified in any other category, except that 2105.2.A.7, "Topsoil Excavation" is included with common excavation, unless modified by the proposal.

(3) MN/DOT 2105.2.A.2, "Subgrade Excavation," is deleted and replaced with the following:

A.2 Subgrade Excavation

All excavation in the road core below the grading grade, exclusive of rock, muck, channel and pond, or rock channel excavation.

(4) MN/DOT 2105.3.B, "Contractor Quality Control (QC) Testing," is deleted and replaced with the following:

B Contractor Quality Control (QC) Testing, Aggregate Certification, and Moisture Requirements

B.1 Contractor Quality Control (QC) Testing

Perform Contractor QC testing as required in the Schedule of Materials Control. Correct areas represented by failing QC or Quality Assurance (QA) tests. Submit test results to the Engineer within one business day.

B.2 Aggregate Certification

Certify granular materials on Form G&B-104, and attach any required tests.

Material placed without certifications is unauthorized work in accordance with 1512, "Unacceptable and Unauthorized Work."

B.3 Moisture Control

Meet the moisture content requirements listed in Table 2105-2.

Table 2105-2	
Moisture Content Requirements	
Compaction Requirement	Relative Moisture Content Requirement *
Minimum of 100% maximum	65% - 102%
Minimum of 95% maximum density	65% - 115%
Quality Compaction	65% - 102%
Penetration Index Method	≥ 65%
* As Determined on Form G&B-105	

Correct moisture content in areas represented by failing moisture tests. Compaction tests taken in areas represented by failing moisture tests are not valid.

Note that optimum moisture content determination tests and moisture tests during compaction are required for all compaction requirements, including quality compaction, LWD, penetration index, and specified density.

The Department's proctor test results are used to determine optimum moisture determination.

(5) MN/DOT 2105.3.G, "Agency Quality Assurance (QA)," is deleted and replaced with the following:

G Agency Quality Assurance (QA)

Test according to the Schedule of Materials Control.

G.1 Material Testing

Sample granular materials from the road core after spreading, but before compaction.

Select crushing, aggregate quality, and bitumen samples using the random sampling method in the Grading and Base manual; additional samples and tests may be taken to delineate visually indicated material failures. Select gradation samples from locations that are at risk of not meeting the specification requirements.

G.2 Compaction Testing

Test for compaction using:

- Quality compaction, and specified density or the LWD method for materials not meeting the requirements of Table 3149-1, 1 Granular Material, or
- Quality compaction, and specified density or granular penetration index or the LWD method for materials meeting the requirements of Table 3149-1, 1 Granular Material.

Test for compaction in areas with the greatest rutting or deflection, and near structures, and in an area at least 1 foot from an unconfined edge.

After Contractor correction of areas represented by a failing test, perform additional tests in areas with the greatest rutting or deflection.

For granular materials with less than 6% passing the #200 sieve, the Engineer may elect to only use the Quality Compaction method, 2105.3.F.2.

Use the specified density method for virgin materials only.

The following method may be used in lieu of point testing (penetration index, specified density, or LWD) for material meeting Table 3149-1, 2 Select Granular Material, when the material thickness is 18 in or less and when not adjacent to Structures per 1103, "Definitions".

The Engineer may elect, with the concurrence of the Contractor, to have the Contractor test roll per 2111, "Test Rolling", material meeting the requirements of Table 3149-1, 2 Select Granular Material, in lieu of point compaction testing. If this method is adapted, the Contractor is required to first place 3 in of base on top of the material meeting Table 3149-1, 2 Select Granular Material, prior to test rolling. For areas failing test rolling, the Contractor is required to remove the base and recompact the material meeting Table 3149-1, 2 Select Granular Material, then place the base back, and retest roll. There is no additional compensation to the Contractor, if this method is adapted. Additionally, the material meeting Table 3149-1, 2 Select Granular Material, is not accepted, until acceptable test rolling has occurred.

Compaction tests taken in areas represented by failing moisture tests are not valid.

G.3 Moisture Testing

Optimum moisture content determination tests and moisture tests during compaction are required for all compaction requirements, including quality compaction, LWD, penetration index, and specified density.

- (6) The last paragraph of MN/DOT 2105.4.B, "Borrow Material," is deleted and replaced with the following:

The Engineer will measure borrow quantities by compacted volume (CV), excavated volume (EV), loose volume (LV), or stockpiled volume (SV).

- (7) MN/DOT 2105.5.K, "Contract Item Schedule," is deleted and replaced with the following:

K Payment Schedule

The Department will pay for excavation and embankment on the basis of the following schedule:

Item No.	Item	Unit
2105.504	Geotextile Fabric Type (1)	square yard
2105.507	Common Excavation	cubic yard
2105.507	Rock Excavation	cubic yard
2105.507	Muck Excavation	cubic yard
2105.507	Subgrade Excavation.....	cubic yard
2105.507	Channel and Pond Excavation.....	cubic yard
2105.507	Rock Channel Excavation	cubic yard
2105.507	Granular Borrow (2)	cubic yard
2105.507	Select Granular Borrow (2, 3)	cubic yard
2105.507	Common Borrow (2)	cubic yard
2105.507	Stabilizing Aggregate (2)	cubic yard
2105.509	Stabilizing Aggregate	ton

- Notes: (1) Specify Type 1, 3, 4, 5, 6, 7, or 8.
(2) Specify basis of measure: EV, LV, SV, or CV. See 2105.4 and 1901.
(3) Specify basis of percent modification (e.g. 5%, 7%, 10% etc.)

2105 EXCAVATION AND EMBANKMENT

Roadway excavation and embankment construction shall be performed in accordance with the provisions of MN/DOT 2105, except as modified below:

A GENERAL

Unless otherwise directed in the Plans or project Special Provisions, compaction of all embankment, including culvert backfills, shall be obtained by the "Specified Density Method" described in MN/DOT 2105.3.F.1. The minimum sampling and testing for compaction shall be in accordance with Appendix B Schedule of Materials Testing – City of Duluth Street and Utility Projects included in these specifications. Additional testing may be performed as determined by the Engineer.

B MATERIALS

Select Granular Borrow (MN/DOT 3149.2.B.2) shall be modified so that of the portion passing a 1 inch sieve, not more than 7 percent by weight will pass a No. 200 sieve.

C NOTIFICATION OF EXCAVATION NEAR GAS MAINS

The City of Duluth gas utility must be notified 2 working days prior to any excavation or directional drilling within 6 feet of a 6 inch or larger natural gas main. Department personnel will be on site to monitor excavation and inspect any exposed main 6 inches or larger. Notify the Utility Operations at 730-4130 to coordinate this inspection.

The Contractor shall notify the City of Duluth gas utility immediately any time a **steel** natural gas main smaller than 6 inches is exposed within an excavation. Contact the Utility Operations at 730-4130 to coordinate an inspection of the exposed main.

D ADJUST WATER SERVICE SHUTOFF STANDPIPES

If the contract does not include a bid item for adjust water service shutoff standpipes, the Engineer will consider any work for adjustment of the water service shutoff standpipes to be incidental to Item 2105.501 Common Excavation. After finish grading and restoration has been completed, the Contractor will provide all labor and incidentals necessary to adjust curb boxes to the correct elevation. The City will provide iron pipe stand pipe, iron pipe sleeves, and iron caps as needed.

2105 GEOTEXTILE FOR SEPARATION (STABILIZATION)

The provisions of MN/DOT 2105 are supplemented with following:

A. Material Requirements

Geotextile shall conform to the requirements of MN/DOT 3733, Type 5, and be non-woven.

B. Construction Requirements

The prepared surface shall be relatively smooth and free of stones, sticks, or other debris or irregularities that would tend to puncture or tear the geotextile. Unless otherwise directed or approved by the Engineer, the geotextile shall be placed with the highest strength direction (usually the "machine" or roll direction) oriented in the direction of the greatest expected field stress. (This will usually be at right angles to the centerline of the construction.)

If multiple pieces of geotextile are required, adjacent strips shall be **field or factory sewn**. The Contractor may use **spray adhesive seams** (meeting MN/DOT Approved/Qualified Products list) as an alternative to sewn seams.

The geotextile shall be adequately secured so that it is not displaced during subsequent construction. No traffic or construction equipment will be permitted to operate directly on the geotextile. Any damaged geotextile shall be repaired to the satisfaction of the Engineer by patching and sewing or, when appropriate, a 36-inch overlap on all sides without sewing.

Fill shall be placed onto the fabric in uniform lifts as required by the applicable specification and approved by the Engineer, but in no case shall lifts in excess of 12-18 inches be used, unless required to bring the fill above water level or provide stability. Fill material shall be as shown in the Plan or as directed by the Engineer. For placement underwater and for two (2) feet above water level, granular materials shall be used unless otherwise provided in the Contract Drawings or approved by the Engineer.

2118 AGGREGATE SURFACING

Revised 12-08-17

SP2018-105: MN/DOT 2118 is modified with the following:

In MN/DOT 2118.5 Basis of Payment, the last paragraph is changed to read as follows:

The Department will pay for aggregate surfacing on the basis of the following schedule:

Item No.	Item	Unit
2118.507	Aggregate Surfacing, (LV), Class ____	cubic yard
2118.507	Aggregate Surfacing, (CV), Class ____	cubic yard
2118.509	Aggregate Surfacing, Class ____	ton

2211 AGGREGATE BASE

New Write-Up 08/09/18

SP2018-107.1 modified: MN/DOT 2211 is modified as follows:

- (1) MN/DOT 2211.3.B, "Contractor Quality Control (QC) Testing," is deleted and replaced with the following:

B Contractor Quality Control (QC) Testing

If required by the Schedule of Materials Control, perform Contractor QC testing and submit results and all required forms to the Engineer within one business day.

Certify materials on Form G&B-104, and attach any required aggregate test results.

Correct base, which fails either QC or Quality Assurance (QA) testing. Correct failing material, before placing the next lift.

- (2) The following is added to MN/DOT 2211.3.D, "Agency Quality Assurance (QA)":

D.4 Moisture Testing

Test for the moisture content in areas that appear least likely to meet specifications. Note that moisture tests during compaction are required for all compaction requirements, including quality compaction, LWD, penetration index, and specified density.

(3) Aggregate base courses for City of Duluth projects shall:

Aggregate for base construction shall conform to the requirements of MN/DOT 3138 and may be sampled, tested, and inspected by the City at any time prior to being incorporated permanently in the work.

The City will measure compaction of aggregate base by the "Specified Density Method" described in MN/DOT 2211.3.D.2.

Materials sampling and testing will be in accordance with Appendix B Schedule for Materials Testing – City of Duluth Street and Utility Projects included in these specifications. Additional testing may be performed as determined by the Engineer.

2215 RECLAMATION

Revised 03/09/18

SP2018-108: MN/DOT 2215 is deleted and replaced with the following:

2215 RECLAMATION

2215.1 DESCRIPTION

This work consists of pulverizing and blending in-place underlying pavements to create an unstabilized or stabilized base. The subsections below are designated so an "A" subsection refers to All Reclamation, a "B" subsection refers to Full Depth Reclamation (FDR), and a "C" subsection refers to Stabilized Full Depth Reclamation (SFDR), as illustrated here:

A All Reclamation

A.1 Definitions

A.1.a Pulverized (un-stabilized) Material

Pulverized material is produced by grinding the bituminous pavement with a portion of the underlying granular material. It may also include additional materials, such as add rock or compaction aids.

A.1.b Bituminous Stabilized Material

Bituminous Stabilized Material is pulverized material that has had a bituminous stabilizing agent (emulsion or foamed asphalt) added to it. It may also include additional materials, such as cement or add rock.

B Full Depth Reclamation (FDR)

This work consists of pulverizing and blending the in-place bituminous pavement with a portion of the underlying material to produce a uniformly mixed aggregate base.

The work includes spreading, watering, compacting, shaping, and maintaining the blended reclaim material to the specified profile and cross-section.

If a compaction aid is used, a second pulverization, mixing, and compaction occurs after the initial phase.

C Stabilized Full Depth Reclamation (SFDR)

Construct a stabilized full depth reclamation (SFDR) layer by:

Pulverizing and blending the in-place bituminous pavement structure with a portion of the underlying material, mixing it with a specified bituminous material and additional materials, if required, shaping and compacting. The process is performed in two steps: an initial pulverization and compaction, and a final pulverization, mixing and compaction.

2215.2 MATERIALS

A All Reclamation

A.1 Additional Aggregates

Provide additional aggregates as required by the Contract.

A.2 Water 3906

B Full Depth Reclamation (FDR)

B.1 Aggregate Base For Reclamation 3135

B.2 Compaction Aids

Provide Compaction aids, if required by the Contract.

C Stabilized Full Depth Reclamation (SFDR)

C.1 SFDR Design Parameters

The mix design criteria for SFDR is in the Grading and Base Manual section 5-692.290. The Agency will provide the mix requirements on Form G&B-408 in the Contract documents.

C.1.a Design Requirements

Meet the mix Design Parameters listed on Form G&B-408.

C.2 Gradation

Meet the gradation requirements of Table 2215-1.

Table 2215-1 Gradation Requirements	
<i>Un-Stabilized Portion</i>	
Sieve Size	Percent Passing
3"	100
2"	90 – 100
<i>Stabilized Portion</i>	
Sieve Size	Percent Passing
1.5"	98 - 100

C.3 Bituminous Material for Mixture.....3151

Use the type and grade of bituminous material for mixture (liquid bituminous material) designated in the mix design on Form G&B-408.

C.4 Mineral Stabilizing Agent (Cement or Lime)

Provide mineral stabilizing agent(s) at the rate required by the Contract.

C.4.a Cement.....3101

C.4.b Hydrated Lime 3106

2215.3 CONSTRUCTION REQUIREMENTS

A All Reclamation

All forms and the Grading and Base Manual are available on the Grading and Base Website. Unless otherwise designated all test procedures are in the Grading and Base Manual.

Repair structures damaged by Contractor operations or negligence.

Correct and re-test all failing areas.

Any failure to meet a requirement creates a Hold Point, whereby no additional material may be placed until Corrective action and passing retest(s) have occurred, or accepted by the Engineer. All additional material placed before corrective action and passing retest(s) occur constitutes Unauthorized Work per 1512.2.

Place geotextiles, if required in the plan or if directed by the Engineer, comply with the requirements of 2105, "Excavation and Embankment."

A.1 Contractor Quality Control (QC) Testing

Perform Contractor QC testing and submit all required forms, if required in the Schedule of Materials Control.

Submit results to the Engineer within one business day after sampling.

Submit to the Engineer the following items:

- (1) a preliminary Grading and Base Report (G&B-001) (required before work commences),
- (2) a final Grading and Base Report (G&B-001) (required within two weeks of completion of project), and
- (3) a weekly summary report of tests completed and retests of failing materials (G&B-003) (required the first working day of the following week).

Sample and test for gradation within the first 500 ft. of production and within 500 ft. after a failing gradation.

Correct and retest all failing areas, which fail either Quality Control or Quality Assurance Testing.

A.2 Agency Quality Assurance (QA) – General

Test according to the Schedule of Materials Control.

B Construction Requirements – Full Depth Reclamation (FDR)

B.1 Contractor Quality Control (QC) – FDR

Perform gradations, moisture tests, depth checks, penetration index tests, test roll, and any other required tests per the Schedule of Materials Control and Contract. Perform test rolling on the top surface per 2111, “Test Rolling,” using test roller TR10.

B.2 Agency Quality Assurance (QA) – FDR

Test compaction using the Penetration Index Method.

Sample for gradation, according to the Grading and Base Manual, after spreading but before compaction.

Observe and document all test rolling, per the Schedule of Materials Control and Contract.

B.3 General FDR Requirements

Remove all reclaimed pavement pieces that would be retained on a three inch sieve, from the right-of-way.

B.4 Equipment Requirements

B.4.a Reclaiming Machine

Use a road reclaiming machine capable of uniformly pulverizing the pavement and the underlying layer to the specified depth and gradation.

B.4.b Rollers

B.4.b.1 Pneumatic-Tired Roller

Use a pneumatic-tired roller weighing at least 25 ton or 616 lb. per in of rolling width. Ensure the tire arrangement allows compaction over the full width of the roller with each pass.

B.4.b.2 Pad Foot Vibratory Roller

If required in 2215.3.B.7, use a pad foot roller weighing at least 25,000 lb.

B.5 Pulverizing Operation

Before beginning pulverization, remove vegetation and topsoil adjacent to the surface.

Blend, add water, spread, compact, and shape pulverized material by the end of the workday.

Protect and avoid damaging Structures during pulverization.

Correct reclaim sections represented by a failing gradation.

B.6 Incorporation of Additional Aggregates and/or Compaction Aids

If required of the Contract, uniformly spread additional aggregates across the roadway surface to be reclaimed before incorporating it into the reclaim mixture.

If required of the Contract, inject and automatically meter compaction aids within the reclaimer using a second reclamation pass.

B.7 Placing and Compacting

Uniformly mix reclamation material before spreading.

Spread and compact the reclamation material to the profile and cross section shown on the plans before placing the next layer.

Maintain the moisture content from 3 to 7 percent by dry weight during compaction.

Place and compact reclamation materials in maximum 3-inch lifts using a pneumatic-tired roller in compliance with 2215.3.B.4.i.

For lifts thicknesses from 3 inches to 6 inches compact using both a pneumatic-tired and pad foot vibratory rollers in compliance with 2215.3.B.4.

The Contractor may use excess reclamation material from other locations on the project to attain the profile or cross-section as shown on the plans.

Compact the full thickness to achieve a penetration index value of 10 mm and a seating value of 40 mm as measured by the MN/DOT Standard Dynamic Cone Penetrometer (DCP) method, as determined by Form G&B-205.

Place and compact to support traffic, while allowing no greater than ½ inch of surface displacement, when measured using a straightedge.

Construct the layer to ±0.05 ft. of the profile and cross-section as required by the contract in accordance with 2112, "Subgrade Preparation."

Place and compact pulverized materials in maximum 6-inch lifts.

B.8 Workmanship, Quality, Repair and Maintenance

The Engineer will provide staking to re-establish the centerline, when Contractor-staking is not required by the contract.

Maintain the compaction, quality, integrity, and properties of the aggregate material in each lift until the next lift or layer is placed.

Repair ruts, potholes, wash-boarding, and other distortions by scarifying to a depth of 2 inches below the deepest distortion and re-compact.

C Construction Requirements – Stabilized Full Depth Reclamation (SFDR)

C.1 General SFDR Requirements

Provide water in order to obtain maximum density.

Stabilize when; The atmospheric temperature is 50°F and rising when using emulsions, 60°F and rising when foaming bituminous, or 40°F and rising when using cement only, it is not foggy or rainy, and freezing temperatures are not predicted within 48 hours after placement of SFDR.

Atmospheric temperature and predicted weather requirements are determined by the Engineer.

C.2 Equipment

C.2.a Reclaiming Machine

Provide a self-propelled reclaiming machine with the ability to:

- (1) Uniformly pulverize the pavement and the underlying layer to the specified depth and gradation requirements of Table 2215-1.
- (2) Thoroughly mix the reclaimed pavement while injecting the liquid bituminous material and automatically metering it with a variation of not more than ± 0.1 percent by weight. It must be capable of adding an additional 6 percent asphalt by total weight.
- (3) Automatically control cross-slope and control cutting depth to within $\pm 1/4$ inch of the depth shown on the plans.
- (4) Maintain the designed asphalt content of overlapped mixtures by adjusting the application of bituminous material for the width of pulverized layer. Automatically maintain the designed asphalt content regardless of machine speed, depth of cut, and number of operating nozzles. Provide means for automatically cleaning nozzles and continual observation and measurement by the operator.
- (5) For foamed asphalt applications, the reclaiming machine must also accurately foam bituminous material and uniformly add specified water and provide samples of the foamed bituminous material through a sampling nozzle.

C.2.b Rollers

C.2.b.1 Pneumatic-Tired Roller

Compact with a pneumatic tired roller meeting the requirements of 2360.3.B.2.e(2) and having a minimum weight of 25 tons.

C.2.b.2 Pad Foot Vibratory Roller

Compact with a pad foot vibratory roller weighing at least 12.5 ton.

C.2.b.3 Steel-Wheeled Roller

Compact with steel-wheeled vibratory rollers equipped with a water spray system meeting the requirements of 2360.3.B.2.e(1).

When using bituminous stabilizers, compact with a double drum roller.

When using cement only, compact with a single drum roller.

C.2.c Bituminous Material for Mixture Supply Tankers

When foaming, tankers must be equipped with a visible thermometer that measures the temperature of the liquid Bituminous Material for Mixture in the bottom third of the supply tank.

C.2.d Vane Feeder

When cement is required, provide a vane feeder capable of uniformly spreading the cement on the road surface prior to reclaiming.

C.2.e Motor Grader

Use a self-propelled motor grader with a minimum 12 foot wide blade.

C.3 Pulverization

Pulverize (grind) and uniformly blend the in-place bituminous pavement with the underlying granular base to the gradation requirements of Table 2215-1.

If required of the Contract, uniformly spread additional material across the roadway surface to be reclaimed before incorporating it into the reclaim mixture.

Correct reclaim sections that do not comply with table 2215-1 by re-pulverizing.

C.4 Spreading & Compaction of the Unstabilized Material

Spread, shape, and compact the pulverized material to the profile and cross section shown on the plans.

Maintain the moisture content from 3 to 7 percent by dry weight during compaction.

Place and compact pulverized (un-stabilized) materials in maximum 6-inch lifts.

Compact the initial pulverized layer to a maximum penetration index value of 10 mm as measured by the MN/DOT standard Dynamic Cone Penetrometer (DCP) device.

Blend, add water, spread, compact, and shape pulverized material by the end of each workday, and before any significant rainfall event occurs.

C.5 Spreading Cement

Spread cement using a vane feeder in a manner that minimizes dusting, i.e. do not spread when the wind is strong enough to coat traffic and/or the environment.

Control the cement content to within ± 0.5 pounds/sy, of the mix design target from Form G&B-408.

Start mixing operations, no longer than 1/2 hour after spreading stabilizing agent.

C.6 Mixing/Injecting

Produce the SFDR layer by mixing and injecting the liquid bituminous material into the pulverized pavement.

Incorporate the bituminous material for mixture at the rate designated on the mix design. However, after consultation with the Contractor, the Engineer may direct the Contractor to vary the application rate of bituminous material for mixture compared to the mix requirements for areas of pulverized bituminous which the Engineer believes are either too rich or too lean.

Use a minimum 6 inch overlap between passes of the reclaimer.

Demonstrate that the asphalt stabilizing agent is uniformly blended into the in-place re-cycle pavement. If the first mixing fails to produce uniformity, remix the stabilized layer until it is achieved.

Maintain bituminous material within $\pm 10^0$ F of the optimum temperature recommended by the mix design (note that bituminous must also meet expansion ratio and half-life foaming tests). If the supplier does not provide a recommendation, maintain the foamed asphalt temperature between 305⁰ F & 325⁰ F.

C.7 Compaction of Bituminous Stabilized Material

Complete the initial compaction (i.e. a pad foot compactor “walks out”) of the bituminous stabilized material prior to shaping.

C.8 Shaping and Compacting of Bituminous Stabilized Material

Remove any remaining pad foot marks and spread the material.

Place and compact the material to within ± 0.05 feet of the profile and so that the cross section has no variations greater than 1/2 inch within 10 feet.

Complete final shaping and compaction within two hours of bituminous material injection.

Within 48 hours of SFDR, re-compact areas represented by density measurements below 97% of the target density determined from the Control Strip, roll until $\geq 97\%$ density is achieved. Note: Do not over-roll to the point where checking of the surface occurs, also note that some areas may not achieve 97% density due to field conditions.

C.8.a Control Strip

Use a control strip to establish a rolling pattern. The control strip should represent a homogenous roadway section and have the following characteristics:

- (1) Minimum area of 400 square yards
- (2) Remain in-place and become a part of the completed work.
- (3) Use the following to establish a rolling pattern after initial breakdown is complete:
Randomly select three test points in the control strip and use a nuclear density device (ASTM D2950, in back-scatter mode) to determine a wet density at each point after each finish (steel) roller pass.
- (4) Ensure that the nuclear gauge rests on a flat surface. The density at each point is defined as the average of two readings offset 180 degrees.
- (5) Continue compacting until additional roller coverage does not produce appreciable increase in density. Provide documentation of the growth curve and maximum target density to the Engineer. Use this for QA/QC process.
- (6) Roll the remainder of that course in accordance with the pattern developed in the control strip for that roller.
- (7) Discontinue and reevaluate the rolling operation (pattern and timing), if surface cracking or checking occurs.

Use this rolling pattern until a new control strip is performed.

Establish a new rolling pattern by performing a new control strip when there are changes in the mixture that cause the original control strip to no longer be representative; changes may include:

- (1) In-place materials variation, including sections with varying thickness, construction history, etc.
- (2) If vehicles leave indents in the compacted surface.
- (3) Changes in RAP gradation
- (4) 97% of Target Density is not achieved on two consecutive QC or QA readings.
- (5) Changes in the application rate of Bituminous Material for Mixture, greater than 0.2% for foaming or 0.3% for emulsion.

C.9 Workmanship, Quality, Repair and Maintenance

Maintain the compaction, quality, integrity, the profile and cross section to within the criteria of 2215.3.C.8, and properties of the SFDR layer during the curing period until the placement of the next layer.

Immediately prior to placement of the next layer, clean the SFDR surface and remove loose aggregate.

The Engineer will provide staking to re-establish the centerline, when Contractor-staking is not required by the contract.

Repair ruts, potholes, wash-boarding, and other distortions.

C.10 Fog Seal and Bituminous Requirements

Apply a CSS-1h bituminous fog seal per 2355, "Bituminous Fog Seal" at a rate of 0.10 to 0.16 gallons per square yard no more than 3 days after the last section has been stabilized.

Place the asphalt pavement:

- (1) No sooner than three calendar days and no later than 14 calendar days after SFDR, at any location, has been injected and compacted (note that the 14 day requirement may be extended with concurrence of the Engineer, if large rainfall events hinder the curing of the SFDR),
- (2) When the SFDR surface does not deflect under construction equipment and meets quality compaction per 2105.3.F.2.
- (3) When the SFDR is capable of meeting the required bituminous placement and compaction requirements.
- (4) When the moisture content of the SFDR is low enough to not migrate into and damage the new asphalt.

2215.4 METHOD OF MEASUREMENT

A BLANK

B Method of Measurement – Full Depth Reclamation (FDR)

The Engineer will measure the reclamation area by the square yard.

C Method of Measurement – Stabilized Full Depth Reclamation (SFDR)

The Engineer will measure the bituminous stabilized full depth reclamation (SFDR) by the square yard.

The Engineer will measure the bituminous material for mixture by the ton.

The Engineer will measure the bituminous fog seal by the gallon.

The Engineer will measure cement by the ton.

The Engineer will measure additional aggregates by the ton.

2215.5 BASIS OF PAYMENT

A All Reclamation

The contract unit prices for reclamation includes the cost of production, testing, placement, occasional variations in the bituminous pavement thickness, removing vegetation and topsoil adjacent to the surface, repair to Structures damaged by Contractor's operations or negligence, and necessary maintenance.

The Agency will pay for the correction of unstable areas through no fault of the Contractor's operations, if directed by the Engineer, per 1402.5, "Extra Work".

The Department will pay for reclamation on the basis of the following schedule:

Item No.	Item	Unit
2215.504	Full Depth Reclamation.....	square yard
2215.504	Stabilized Full Depth Reclamation	square yard
2215.507	Haul Full Depth Reclamation (LV)	cubic yard
2215.509	Bituminous Material for Mixture	ton
2215.509	Aggregate Base	ton
2215.509	Cement.....	ton

2301 CONCRETE PAVEMENT

Revised 01/04/19

SP2018-124: MN/DOT 2301 is hereby modified as noted in Appendix E – "Supplemental Concrete Specifications" of these Construction Standards.

2301 DOWEL BAR

Revised 10/20/17

SP2018-125: MN/DOT 2301 is hereby modified as follows:

1. MN/DOT 2301.2.F is modified to include the following:

Provide dowel bars meeting one of the following:

- (1) Epoxy coated dowel bars in accordance with 3302, "Dowel Bar", or
- (2) Galvanized tubular dowel bars in accordance with 3302, "Dowel Bar."

Do not intermix different dowel types or sizes unless allowed by the Concrete Engineer.

2301 DRILL AND GROUT REINFORCEMENT BAR (EPOXY COATED)

Revised 10/20/17

SP2018-126: MN/DOT 2301 is hereby modified as follows:

This work shall consist of drilling, grouting, and inserting No. 5 epoxy coated reinforcement bars in accordance with the provisions of MN/DOT 2301 and the following:

MEASUREMENT AND PAYMENT

Measurement will be by the number of epoxy coated reinforcement bars that are furnished, installed, and grouted in place as specified. Payment will be under Item 2301.602 (Drill and Grout Reinforcement Bar (Epoxy Coated)) at the Contract bid price per each, which shall be payment in full for all work included under this section.

2301 CONCRETE PAVEMENT LUGS

Revised 10/20/17

SP2018-129: MN/DOT 2301 is hereby modified as follows:

This work shall consist of constructing concrete pavement lugs in accordance with the detail shown on Sheet No.STR-10 of the Standard Details in Appendix D of this Construction Standard, the provisions of MN/DOT 2301, and the following:

MEASUREMENT AND PAYMENT

Measurement will be by the length of pavement lugs constructed as specified. Payment will be under Item 2301.603 (Concrete Pavement Lugs) at the Contract bid price per linear foot, which shall be payment in full for all costs involved.

2301 SLAB JACKING

REVISED 10/20/17

SP2018-130 modified: MN/DOT 2301 is hereby modified as follows:

This work is raising in place concrete pavement, driveway, and sidewalk panels by a mud-jacking/pressure grouting process in accordance with the applicable provisions of MN/DOT 2301 and the following:

Furnish all labor, equipment, and material, including traffic control, necessary to perform the work intended. Place sufficient portable weights or other means on the panel to prevent uplift at the adjacent panel during the mud-jacking process, as directed by the Engineer.

Submit a layout of the mud-jack hole location and spacing for each proposed bridge approach panel to the Engineer for approval. The Engineer will approve each layout before drilling is started. Provide a 2-1/2 inch diameter hole size with alternate sizes approved by the Engineer.

The spacing and location of the mud-jack holes will vary depending upon the amount that the panel is to be raised and if the existing panel is cracked. The Engineer will determine the final elevation of each approach panel. Typical hole spacing is shown in the Plan. Hole spacing shall not exceed 6 feet center-to-center so that not more than 25 to 30 square feet of panel is raised by pumping at any one hole. The Engineer may require additional holes, if the panel is cracked. The location of the holes should avoid drilling into the panel lug or shallow utility pipes as shown in the Plan. Refer to the Plan details or project Special Provisions for existing panel reinforcement. The Contractor should employ an experienced operator to make the decision on the hole spacing.

Provide an experienced individual to make the decision on the consistency of the mixture and the volume of each batch mixed. Provide a mudjack mixture consisting of the following:

<u>Ingredient</u>	<u>Weight</u>
Cement	425 pounds [193 kg]
Fly Ash	335 pounds [152 kg]
Agricultural Lime	2295 pounds [1041 kg]
Water	Enough to attain a thick creamy texture

Drill all holes for the mud-jacking for the entire panel before jacking is started. Start mud-jacking at the lowest outboard corner of the panel and proceed towards the adjacent panel. Perform jacking in stages while carrying traffic in the adjacent lane. The Engineer may require alternate shifting of a lane closure.

Mud-jack on a continuous basis without interruption (except for a traffic shift) on each panel until the desired lift is achieved or as directed by the Engineer. Clean and fill mud-jack holes with concrete as directed by the Engineer.

Construct a temporary bituminous ramp from the in place roadway to the newly raised panel, under flag person control, as many times as necessary during the mud-jacking process as directed by the Engineer. Maintain the temporary ramps until removal is necessary to place the permanent surfacing. Remove the ramps.

MEASUREMENT

Measurement will be by the entire surface area of any bridge approach panel that is raised without regard to the number of holes drilled, the amount of mud-jack material used, or the distance that the panel is raised.

PAYMENT

Payment for mud-jacking bridge approach panels will be under Item 2301.604 (Slab Jacking) at the Contract bid price per square yard, which is compensation in full for all costs, including traffic control, and all labor, materials, equipment necessary to perform the work, and place, maintain, remove temporary bituminous ramps.

2302 CONCRETE PAVEMENT REHABILITATION (CPR)

REVISED 01/25/19

SP2018-131: MN/DOT 2302 is hereby supplemented as noted in Appendix E – “Supplemental Concrete Specifications” of these Construction Standards.

In addition, Refer to Appendix F “Concrete Pavement Rehabilitation (CPR) Standard Details.

2357 BITUMINOUS TACK COAT

Bituminous tack coat work shall be provided in accordance with MN/DOT 2357 except as modified as follows:

- A. MN/DOT 2357.1 Description is supplemented with the following:
The Contractor shall coat the vertical surfaces of ALL edges abutting the asphalt pavement. When placing tack coat, the Contractor shall overspray (not more than 2 inches) the longitudinal joint of the adjacent road surface to seal the joint.
- B. Delete section MN/DOT 2357.4 Method of Measurement and section MN/DOT 2357.5 Basis of Payment and replace with:
No measurement will be made of bituminous material for tack coat and no direct compensation will be made. All costs for providing bituminous materials for tack coat will be incidental.

2360 PLANT MIXED ASPHALT PAVEMENT

MN/DOT 2360 specification is modified and/or supplemented with the following:

- A. MN/DOT 2360.1 Description is supplemented with the following:
Unless otherwise indicated in the Plan or project special provisions, asphalt mixtures shall be:
- | | |
|--------------------------------|-----------|
| Type SP9.5 Wearing Course | SPWEA340C |
| Type SP12.5 Non-Wearing Course | SPNWB330C |
- Unless otherwise indicated in the Plan or project special provisions, asphalt mixture for 'Street Restoration Patching' described elsewhere in these Construction Standards shall be:
- | | |
|----------------------------|-----------|
| Type SP12.5 Wearing Course | SPWEB340B |
|----------------------------|-----------|
- B. MN/DOT 2360.2 Materials is modified with the following:
Asphalt binder meeting AASHTO M332 (MSCR) is required. See Section 3151 (BITUMINOUS MATERIAL (MSCR)) of these Construction Standards.
- C. The first paragraph of MN/DOT 2360.2.G.4.b Sampling and Testing is revised with the following:

Take QC samples at random tonnage or locations, quartered from a larger sample of mixture. Sample randomly and in accordance with the Schedule of Materials Control. Determine random numbers and tonnage or locations using the Bituminous Manual; Section 5-693.7 Table A or ASTM D 3665, Section 5, or, an Engineer approved alternate method of random number generation. ~~Sample either behind the paver or from the truck box at the plant site. Other sampling locations can be approved by the Engineer. The Contractor must decide and notify the Engineer where samples will be taken before production begins. The Contractor and Engineer must both agree to a change of sampling location once production has begun.~~ **Sample mixture from behind the paver. Sampling from the truck box at the plant site is not allowed unless approved by the Engineer. In addition to the QC sample, the Contractor will also bring an additional split of the mixture sample to the plant site and store for the Department for 10 calendar days.** The procedure for truck box sampling is on the Bituminous Office website. The Contractor will obtain at least a 130-pound sample. Split the sample in the presence of the Inspector. The Inspector will retain possession of the Agency portion of each split sample and randomly submit a minimum of one sample, on a daily basis, to the District Laboratory for Verification testing (see 2360.2.G.3). Store compacted mixture specimens and loose mixture companion samples for 10 calendar days. Label these split companion samples with companion numbers.

- D. The provisions of MN/DOT 2360.2.G.8 Documentation are hereby modified with the following:

Delete "District Materials Laboratory" and replace with "City of Duluth's Project Engineer".

The City will assess monetary deductions in the amount of \$250.00 each day that the Contractor fails to comply.

- E. MN/DOT 2360.3.B.3 Tack Coat is supplemented with the following:

The Contractor shall coat the vertical surfaces of ALL edges abutting the asphalt pavement. When placing tack coat, the Contractor shall overspray (not more than 2 inches) the longitudinal joint of the adjacent road surface to seal the joint.

- F. The provisions of MN/DOT 2360.3.D Compaction are hereby modified with the following:

- (1) The first paragraph of MN/DOT 2360.3.D.1 is hereby deleted and replaced with the following:

D.1 Maximum Density

Compact the pavement to at least the minimum required maximum density values in accordance with Table 2360-19, "Required Minimum Lot Density (Mat)".

- (2) MN/DOT Table 2360-20 Longitudinal Joint Density Requirement is hereby deleted.

- (3) MN/DOT 2360.3.D.1.h Mat Density Cores is hereby deleted and replaced with the following:

D.1.h Mat Density Cores

Obtain four cores in each lot. Take two cores from random locations as directed by the Engineer. Take the third and fourth cores, the companion cores, within 1 foot longitudinally from the first two cores. Submit the companion cores to the Engineer immediately after coring and sawing. If the random core location falls on an unsupported joint, at the time of compaction, (the edge of the mat being placed does not butt up against another mat, pavement surface, etc.) cut the core with the outer edge of the core barrel 1 foot [0.3 meters] away (laterally) from the edge of the top of the mat (joint). If the random core location falls on a confined joint (edge of the mat being placed butts up against another mat, pavement surface, curb and gutter, or fixed face), cut with the outer edge of the core barrel 6 inches $\pm$ 0.5 inch from the edge of the top of the mat (ex. center of 4 inch core barrel 8 $\pm$ 0.5 inches from the edge of the top of the mat). Cores will not be taken within 1 foot of any unsupported edge. The Contractor is responsible for maintaining traffic, coring, patching the core holes, and sawing the cores to the paved lift thickness before density testing.

The Engineer may require additional density lots to isolate areas affected by equipment malfunction, heavy rain, or other factors affecting normal compaction operations.

- (4) MN/DOT 2360.3.D.1.j Companion Core Testing is hereby deleted and replaced with the following:

The Department will select at least one of the two companion cores per lot to test for verification.

- (5) MN/DOT 2360.3.D.1.n Longitudinal Joint Density is hereby deleted.

- (6) MN/DOT 2360.3.D.1.p Shoulders is hereby deleted.

- (7) MN/DOT Table 2360-24 Payment Schedule for Longitudinal Joint Density (SP Non-Wear and SP Shoulders, 4% Void) is hereby deleted.

- (8) MN/DOT Table 2360-25 Payment Schedule for Longitudinal Joint Density (SP Non-wear and SP Shoulders, 3% Void) is hereby deleted.

- (9) MN/DOT 2360.3.D.1.r Pay Factor Determination is replaced with the following:

The City will make payment based on either 1) Mat Density Pay Factor A on Table 2360-22 ONLY, with no adjustment for longitudinal joint density; or 2) the Payment % from Table 2360-23.

- G. MN/DOT 2360.3.E Surface Requirements is hereby supplemented with the following:

Unless otherwise indicated in the Plan or project special provisions, the City will NOT evaluate Pavement Surface Smoothness (MN/DOT 2399).

2360 PLANT MIXED ASPHALT PAVEMENT – STREET RESTORATION PATCHING

The provisions of MN/DOT 2360 and the City of Duluth Standard Specifications are supplemented with the following:

A. Description

This work shall consist of providing plant mixed asphalt pavement to restore patches of the existing street pavement that are removed or damaged as a result of miscellaneous construction activities that do not include full-lane plant mixed asphalt pavement paving work as part of the project.

A street restoration patch will be defined generally as a small or minor area within an existing asphalt street pavement where the size or shape of the patch area preclude the use of standard asphalt street paving equipment.

The existing pavement shall be sawn full depth to create a neat clean edge to match the street restoration patch. Where the Contract does not include a sawing bid item, sawing shall be incidental.

Asphalt pavement street restoration patch thickness shall match the existing asphalt pavement section or unless otherwise provided in the Plan Details. Where there is no concrete base, the asphalt pavement shall be a minimum of 3.5 inches thick, placed in two layers.

For asphalt pavement on concrete base sections, the replacement concrete base shall be provided to the same thickness as the existing base section. The replacement base pavement shall be tied to the existing base panels with #5 epoxy coated rebar spaced not more than 18 inches on center. Joints shall be cut or tooled to match the original panel layout. Concrete base pavement joints shall not be sealed. Concrete base pavement surface shall not be "tined". Concrete base pavement shall be cured a minimum of 4 days prior to placing asphalt overlay.

Unless otherwise indicated in the Plans or special provisions, asphalt mixture for street restoration patch shall be: SP 12.5 Wearing Course Mixture (3,B) (SPWEB340B)

B. Materials

- 1) MN/DOT 2360.2 Materials is supplemented with the following: The Contractor shall submit Mixture Design to the Engineer at least 14 days prior to the asphalt paving work.
- 2) MN/DOT 2360.2.G Mixture Quality Management is supplemented with the following: The Contractor shall provide copies of testing results to the Engineer upon request.

C. Construction Requirements

- 1) MN/DOT 2360.3.B.2.e Rollers is supplemented with the following: The use of mechanical tampers or skid plate compactors will only be considered acceptable with the written authorization of the Engineer prior to the work.
- 2) MN/DOT 2360.3.B.3 Tack Coat is supplemented with the following: The Contractor shall coat the vertical surfaces of all edges abutting the asphalt pavement street restoration patch.

- 3) MN/DOT 2360.3.D Compaction is supplemented with the following: Unless otherwise noted, the density of asphalt pavement for street restoration patch will be evaluated by "Ordinary Compaction" method.
- 4) MN/DOT 2360.3.E Surface Requirements apply to the work of asphalt pavement for street restoration patch.
- 5) MN/DOT 2360.3.E.1 Lift Thickness is supplemented with the following: Unless otherwise noted in the Plan details, the work shall be constructed with a maximum lift thickness of 3 inches.

D. Method of Measurement

MN/DOT 2360.4 Method of Measurement is supplemented as follows: Where the actual total thickness of asphalt pavement for street restoration patch varies from the Contract bid items, the Engineer will prorate the quantities measured based on an adjustment factor determined by the ratio of actual thickness to bid item thickness.

E. Basis of Payment

MN/DOT 2360.5 Basis of Payment is supplemented as follows: The accepted quantities of asphalt pavement mixture for street restoration patch used in each course at the Contract prices per unit of material shall be compensation in full for all costs of constructing the asphalt surfacing and providing or incorporating asphalt binder, tack coat, mineral filler, hydrated lime, and anti-stripping additives that may be permitted or required.

Payment will be made for asphalt pavement for street restoration patch under Item 2360.604 Type SP 12.5 Wearing Course Mixture (3,B) Street Restoration Patch (x)" Thick at the contract unit price per square yard.

Note: (x) Total Thickness of asphalt pavement for street restoration patch. Thicknesses greater than 3 inches SHALL be placed in multiple lifts as directed by the Engineer.

2399 PAVEMENT SURFACE SMOOTHNESS

MN/DOT 2399 is hereby deleted and the pavement surface smoothness requirements will not apply.

However, the provisions of 2360.3.E Surface Requirements will apply.

2402 PIPE RAILING

The provisions of MN/DOT 2402 are supplemented with the following:

Paint color for pipe railings shall be BLACK.

All metals shall be cleaned to SSPC-SP-6, commercial grade blast. Primer shall be one coat of Polyamidoamine Epoxy, Sherman Williams Macropoxy 646 or equal, to a DFT of not less than 4.0 mils. Final coat shall be one coat of Polyamidoamine Epoxy, Sherman Williams Macropoxy 646 or equal, to an average DFT of 2 to 3 mils.

Recoat as needed in field to cover metal exposed during installation.

2411 MINOR CONCRETE STRUCTURES

This work shall consist of constructing concrete structures in accordance with MN/DOT 2411 and the following:

A. Description

- 1) Concrete Steps shall be constructed as shown in Standard Detail STR-7.
- 2) Concrete retaining wall shall be constructed as shown in Standard Detail STR-6.

B. Measurement

Concrete steps and concrete retaining wall will be measured by volume of concrete placed and accepted with no deductions for reinforcement bar.

C. Basis of Payment

Payment for the items below will be made at the Contract bid price per unit, which shall be compensation in full for all labor, equipment, and material costs necessary to complete the work including, but not limited to, excavation, removals, aggregate bedding, reinforcement bar, structural concrete, backfill, and surface finishing.

<u>Item</u>	<u>Description</u>	<u>Unit</u>
2411.607	Concrete Steps	Cubic Yard
2411.607	Concrete Retaining Wall, Type L	Cubic Yard

2451 EXCAVATION, BACKFILL AND COMPACTION FOR UTILITIES

This work shall consist of furnishing all materials, labor, equipment, and other services as are necessary for preparing the site for work, the excavating, preparing the trench for the utility pipeline to be altered or installed, the backfilling and compaction. The excavation and backfill aspects of the work required for sewer, water, and gas utilities shall meet MN/DOT 2451 except as modified in the following:

A. DESCRIPTION

MN/DOT 2451.1 Description is supplemented with the following:

The City of Duluth considers sanitary, storm, water, and gas utility pipe, manholes, catch basins, hydrants, and valves to be 'prefabricated'.

B. USE OF ON-SITE MATERIALS

Where acceptable (suitable) select grading material **is available** within the project site, the select grading materials shall be utilized for backfilling pipe trench from the top of pipe encasement zone up to the subgrade (bottom of road section or bottom of topsoil) at the direction of the Engineer.

C. MATERIALS

MN/DOT 2451.2 Materials is supplemented with the following:

1. Suitable On-Site Backfill Material

Suitable materials shall be defined as a mineral soil reasonably free of foreign materials (rubbish, debris, etc.), frozen clumps, aggregate larger than 3 inches, rock, concrete or asphalt chunks, and other unsuitable materials, that may damage the pipe installation, prevent thorough compaction, or increase the risks of after settlement unnecessarily. Suitable backfill shall meet the provisions of MN/DOT 2105.1A.6 Select Grading Material. Suitable backfill shall not include recycled asphalt or concrete materials. The Engineer shall determine if any material is suitable.

2. Imported Granular Materials for Pipe Bedding and Encasement

Granular materials furnished for foundation, bedding, pipe encasement, or other purposes as may be specified shall consist of any natural mineral aggregate such as sand, gravel, crushed rock, crushed stone, that shall meet the gradation requirements specified on the Standard Details, the Contract Drawings and the Special Provisions. Granular material used for pipe bedding and encasement shall be comprised of Virgin Materials (3149.2.A.1) only. Recycled Materials (3149.2.A.2) will NOT be acceptable for utility backfill.

3. Imported Granular Materials for Manholes and Catch Basins

Granular materials furnished for foundation and bedding shall consist of granular materials as specified on the Standard Details, the Contract Drawings and the Special Provisions. Structure backfill for manholes and catch basins shall meet MN/DOT 3149.2.D.1 Granular Backfill. Granular material used for foundation, bedding, and backfill of utilities structures shall be comprised of Virgin Materials (3149.2.A.1) only. Recycled Materials (3149.2.A.2) will NOT be acceptable for utility backfill.

4. Imported Materials for Backfill

Where acceptable select grading material **is not available** within the project site, the Contractor shall furnish granular backfill meeting MN/DOT 3149.2.D.1 Granular Backfill or common backfill meeting MN/DOT 2105.1.B Common Borrow which shall be utilized for backfilling from the top of pipe encasement zone up to the subgrade (bottom of road section or bottom of topsoil) at the direction of the Engineer. Granular material used for backfill of utilities pipes and structures shall be comprised of Virgin Materials (3149.2.A.1) only. Recycled Materials (3149.2.A.2) will NOT be acceptable for utility backfill.

Where the backfill materials are not specified in the Plans or Special Provisions, it shall be Granular Backfill meeting MN/DOT 3149.2.D.1. (<20% passing No.200 sieve/1in).

D. CONSTRUCTION

1. General Provisions

- a) Protection of Surface Structures. All surface structures and features located outside the permissible excavation limits for underground installations, together with those within the construction areas which are indicated in the Contract Drawings as being saved, shall be properly protected against damage and shall not be disturbed or removed without approval of the Engineer. Within the construction limits, as required, the removal of improvements such as paving, curbing, walks, turf, etc., shall be subject to acceptable replacement of underground work, with the expense of removal and replacement being borne by the Contractor to the extent that separate compensation is not specifically provided for in the Contract.

Obstruction such as street signs, traffic control signs, guard posts, small culverts, and other items of prefabricated construction may be temporarily removed during construction provided that essential service is maintained in a relocated setting as approved by the Engineer and that nonessential items are properly stored for the duration of construction. Upon completion of the underground work, all such items shall be replaced in their proper setting at the sole expense of the Contractor.

- b) Interference of Underground Structures. When any underground structure interferes with the planned placement of the pipeline or appurtenances to such an extent that alterations in the work are necessary to eliminate the conflict or avoid endangering effects on either the existing or proposed facilities, the Contractor shall immediately notify the Engineer and the Owner of the affected structure. When any existing facilities are endangered by the Contractor's operations, he shall cease his operations at the site and take such precautions as may be necessary to protect the in-place structures until a decision is made as to how the conflict will be resolved.

The City of Duluth gas utility must be notified 2 working days prior to any excavation or directional drilling within 6 feet of a 6 inch or larger natural gas main. Department personnel will be on site to monitor excavation and inspect any exposed steel main 6 inches or larger. Notify the Utility Operations at 730-4130 to coordinate this inspection.

The Contractor shall notify the Engineer immediately any time a steel natural gas main smaller than 6 inches is exposed within an excavation. Contact the Utility Operations at 730-4130 to coordinate an inspection of the exposed main.

Without specific authorization from the Engineer, no essential utility service shall be disrupted, nor shall any change be made in either the existing structures or the planned installations to overcome the interference. Alterations in existing facilities will be allowed only to the extent that service will not be curtailed unavoidably and then only when the encroachment or relocation will satisfy all applicable regulations and conditions.

Whenever alterations are required as a result of unforeseen underground interferences not due to any fault or negligence of the Contractor, the Engineer will issue a written order covering any additional or extra work involved and specifying

the revised basis of payment, if any. Any alterations made strictly for the convenience of the Contractor shall be subject to prior approval. If an alteration diminishes the Contractor's responsibilities under the Contract in providing services or materials, a deduction will be made from the Contractor's final payment by a change order. No extra compensation will be allowed for delays caused by the interference of underground structures.

- c) Temporary Surface Measures. While any open excavations are maintained, the Contractor shall have available a supply of steel plates suitable for temporary bridging of open trench sections where either vehicular or pedestrian traffic must be maintained. Use of the plates shall be as directed or approved by the Engineer and where installed they shall be secured against possible displacement and be replaced with the permanent structure as soon as possible.

2. Excavation and Repair of Trench

- a) Operational Limitations and Requirements. Excavating operations shall proceed only so far in advance of pipe installation as will satisfy the need for coordination of work and permit advance verification of unobstructed line and grade as planned. At no time shall over 400 lineal feet of excavated trench be open at one time. Where interference with existing structures is possible or in any way indicated, and where necessary to establish elevation or direction for connection to in-place structures, the excavating shall be done at those locations in advance of the main operation so actual conditions will be exposed in sufficient time to make adjustments without resorting to extra work or unnecessary delay.

All installations shall be accomplished by open trench construction except for short tunnel sections approved by the Engineer and with the exception that boring, directional drilling, jacking, insertion in existing pipe or tunnel construction methods shall be employed where so specifically required by the Contract Drawings or Special Provisions. Installation of pipe through tunnel excavations will be allowed only where the surface structure can be properly supported and the backfill restored to the satisfaction of the Engineer.

The excavating operations shall be conducted so as to carefully expose all in-place underground structures without damage. Wherever the excavation extends under or approaches so close to an existing structure as to endanger it in any way, precautions and protective measures shall be taken as necessary to preserve the structure and provide temporary support. Hand, vacuum, or other non-evasive methods of excavating shall be utilized to probe for and expose such critical or hazardous installations as gas pipe and power or telephone cables.

The Engineer shall be notified of any need for blasting to remove materials which cannot be broken up mechanically, and there shall be no blasting operations conducted until the Engineer's approval has been secured. All blasting shall be performed in accordance with 2105/2451 ROCK BLASTING AND VIBRATION CONTROL specifications.

- b) Classification and Disposition of Materials. Rock will be paid for separately from other unclassified materials, either as a separate Contract Item or as an Extra Work Item when no bid price is applicable. All other materials encountered in the excavations, with the exception of items classified for payment as structure removals, will be considered as Unclassified Excavation. Unclassified materials shall include muck, rubble, wood debris, and boulder stone, masonry, or concrete fragments less than one quarter cubic yard in volume, together with other miscellaneous matter that can be removed effectively with power operated excavators without resorting to drilling and blasting.

For water, sanitary sewer and storm sewer, Rock Excavation shall be defined to include all hard, solid rock in ledge formation, bedded deposits and unstratified masses; all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; and any boulder, stone, masonry or concrete fragments exceeding **one cubic yard in volume**. Materials such as shale, hard pan, soft or disintegrated rock which can be dislodged with a hand pick or removed with a power operated excavator will not be classified as Rock Excavation.

For natural gas pipe, Rock Excavation shall be defined to include all hard, solid rock in ledge formation, bedded deposits and unstratified masses; all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock. Boulder Excavation shall be defined to include any boulder, stone, masonry or concrete fragments exceeding **one-quarter cubic yard in volume**. Materials such as shale, hard pan, soft or disintegrated rock which can be dislodged with a hand pick or removed with a power operated excavator will not be classified as Rock Excavation or Boulder Excavation.

Excavated materials will be classified for reuse as being either suitable or unsuitable for other specified use as determined by the Engineer. All suitable materials shall be reserved for backfill where allowed and to the extent needed as called for on the Contract Drawings or in the Special Provisions, and any surplus remaining shall be utilized for other construction on the project as may be specified or ordered by the Engineer. To the extent practicable, granular materials and topsoil shall be segregated from other materials during the excavating and stockpiling operations so as to permit best use of the available materials at the time of backfilling.

All excavated materials reserved for backfill or other use on the project shall be stored at locations approved by the Engineer that will cause a minimum of inconvenience to public travel, adjacent properties, and other special interests. The material shall not be deposited so close to the edges of the excavations as would create hazardous conditions, nor shall any material be placed so as to block the access to emergency services. All materials considered unsuitable by the Engineer, for any use on the project, shall be immediately removed from the project and disposed of as arranged for by the Contractor.

- c) Excavation Limitations and Requirements—Open Trench. Trench excavating shall be to a depth that will permit preparation of the trench bottom as shown on the Contract

Drawings and installation of the pipeline and appurtenances at the prescribed line and grade, except where alterations are specifically authorized. Trench widths shall be as shown on the Standard Details and Contract Drawings and shall be sufficient to permit the pipe to be laid and joined properly and the backfill to be placed and compacted as specified. Extra width shall be provided as necessary to permit convenient placement of sheathing and shoring, to accommodate placement of appurtenances, or to make connections. No payment will be made for extra width required for the contractors shoring. The contractor shall notify the engineer prior to excavating any additional material outside the standard trench width.

Excavations shall be extended below the bottom of structure grade only if necessary to accommodate any required bedding material. When rock or unstable foundation materials are encountered at the established grade, additional materials shall be removed as specified or ordered by the Engineer to produce an acceptable foundation. Unless otherwise indicated or directed, rock shall be removed to an elevation at least six inches below the bottom surface of the pipe barrel.

Minimum and maximum width of utility trenches shall be as shown on the Standard Details or Contract Drawings.

Maximum allowable trench width for combined utilities shall be the maximum required separation between pipelines plus the outside diameters of each pipe plus 24 inches.

The maximum allowable trench widths shown on the Standard Details or Contract Drawings shall be used to establish maximum payment volume for granular backfill and rock excavation. Where the trench width was exceeded due to conditions which the Contractor could have controlled using reasonable methods to secure a trench, no additional payments for granular backfill will be made.

When no other grade controls are indicated or established for the pipeline, the excavation and foundation preparations shall be such as to provide a minimum cover over the top of the pipe as specified. Trench widths shall allow for at least six inches of clearance on each side of the joint hubs. The width of the trench at the ground surface shall be held to a minimum to prevent unnecessary destruction of the surface structures.

- d) Sheathing and Braced Excavations. All excavations shall be sheathed, shored and braced as will meet all requirements of OSHA; shall comply with any specific requirements of the Contract; and prevent disturbance or settlement of adjacent surfaces, foundations, structures, utilities, and other properties. Any damages to the work under contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to failure or lack of sheathing, shoring or bracing or through negligence or fault of the Contractor in any manner shall be repaired by the Contractor at his expense and without delay.

Where conditions warrant extreme care, the Contract may require special precautions to protect life or property, or the Engineer may order the installation of sheet piling of the interlocking type or direct that other safety measures be taken as he deems necessary. Failure of the Engineer to order correction of improper or inadequate sheathing, shoring, or bracing shall not relieve the Contractor of his responsibilities for protection of life, property, and the work. The contractor shall assume full responsibility for proper and adequate placement of sheathing, shoring, and bracing, wherever and to such depths that soil stability may dictate the need for support to prevent displacement. Bracing shall be so arranged as to provide ample working space and so as not to place stress or strain on the in-place structures to any extent that may cause damage.

Sheathing, shoring and bracing materials shall be removed only when and in such a manner as will assure adequate protection of the in-place structures and prevent displacement of supported grounds. Sheathing and bracing shall be left in place only as required by the Contract or ordered by the Engineer. Otherwise, sheathing and bracing may be removed as the backfilling reaches the level of respective support. Wherever sheathing and bracing is left in place, the upper portions shall be cut and removed to an elevation of three feet or more below the established surface grade as the Engineer may direct.

All costs of furnishing, placing and removing sheathing, shoring and bracing materials, including the value of materials left in place as required by the Contract, shall be included in the prices bid for pipe installation and will not be compensated for separately. When any sheathing, shoring or bracing materials are left in place by written order of the Engineer, in the absence of specific requirements of the Contract to do so, payment will be made for these materials as an Extra Work Item, including waste material resulting from upper cut-off requirements.

- e) Preparation and Maintenance of Foundations and Bedding. Foundation preparations shall be conducted as necessary to produce a stable foundation and provide continuous and uniform pipe bearing between bell holes. Over excavation shall be performed as necessary to allow installation of bedding where called for on the Standard Details, Contract Drawings or Special Provisions. The initial excavation or bedding operations shall produce a subgrade level slightly above finished grade as will permit hand shaping to finished grade by trimming of high spots and without the need for filling of low spots to grade. Bell hole excavations shall be made at each joint as will permit proper joining of pipe and fittings.

Where the foundation soil is found to consist of materials that the Engineer considers to be so unstable as to preclude removal and replacement to a reasonable depth to achieve solid support, a suitable foundation shall be constructed as the Engineer directs in the absence of special requirements therefore in the Contract. The Contractor may be required to furnish and drive piling and construct concrete or timber bearing supports or other work as may be provided for in an Extra Work order.

Care shall be taken during the final subgrade shaping to prevent any over-excavation. Should any low spots develop, they shall only be filled with approved material, which shall have optimum moisture content and be compacted thoroughly. The finished subgrade shall be maintained free of water and shall not be disturbed once established. Where pipe lowering operations are to occur, excavation may be required as necessary to remove pipe slings.

All costs of excavating below grade and placing foundation or bedding materials as required shall be included in the unit price bid for the related utility. Any excavation below grade and any foundation or bedding aggregates required by order of the Engineer in the absence of Contract requirements therefore will be compensated for separately as Extra Work items.

f) Dewatering

All excavation for utility pipe or structures shall be dry and free from water as necessary to provide a stable foundation. The Contractor shall provide all necessary dewatering equipment and all necessary equipment or materials for water quality treatment when necessary. Discharge from dewatering operations shall meet all federal, state and city standards prior to entering any water course or storm sewer.

MN/DOT 2451.3.D Backfilling Excavations is supplemented with the following:

3. Backfilling Operations

- a) General Requirements. Sequence of operations necessary prior to commencing final backfilling may be governed by the Standard Details, Contract Drawings, Special Provision, or the Specifications. Backfilling prior to completing other requirements will, at the option of the Engineer, result in removal of backfill as necessary at no extra cost to the City. Elevations and measurements of existing or new exposed utilities are of primary importance prior to backfilling.

All pipeline excavations shall be backfilled as will restore pre-existing conditions as the minimum requirement, and fulfill all supplementary requirements indicated in the Standard Details, Contract Drawings and Specifications. The backfilling operations shall be started as soon as conditions will permit on each section of pipeline, so as to provide continuity in subsequent operations and restore normal public service as soon as practicable on a section-by-section basis.

- b) Temporary Aggregate Base Surface. Trench surfaces which are to be restored with concrete or bituminous pavements constructed by others shall have the top 18 inches backfilled to match the elevation of the existing surface with MN/DOT 3138 Class 5 aggregates. The temporary surface shall be opened to traffic where necessary and maintained by the Contractor until immediately prior to paving. At such time, the surface shall be excavated to provide for the depth of the permanent pavement.
- c) Placement Procedure and Compaction. Initial backfill and pipe encasement materials shall be installed immediately following pipe installation. The pipe encasement area shall include all backfill up to 12 inches above the top of pipe for water and sewer and

6 inches for natural gas lines. The pipe shall be secured in place with backfill materials to the mid-point prior to covering the pipe or compacting. Utility trench compaction will be measured by MN/DOT 2105.3.F.1 Specified Density method as follows:

- Compaction of materials placed within the pipe bedding and encasement zones shall be accomplished with portable or hand equipment methods, so as to achieve thorough consolidation under and around the pipe and avoid damage to the pipe. The materials at this level shall be thoroughly compacted with a mechanical compactor to meet **95% of maximum standard proctor density**.
- Above the pipe encasement zone (and below subgrade), backfill materials shall be carefully placed in relatively uniform depth layers spread over the full width and length of the trench section and as will provide simultaneous support on both sides of the excavation. Compaction of backfill for utility pipe trench shall be meet **100% of maximum** standard proctor density for the **upper 3 feet below subgrade**; and **95% of maximum** standard proctor density **below the upper 3 feet**.
- Compaction of backfill for manholes and catch basin structures shall meet **100% of maximum** standard proctor density for **full depth** from bedding up to subgrade.

These compaction requirements apply to both mainline and service pipes with no differentiation made for pipe or structures located “outside” the roadway.

The minimum sampling and testing for compaction shall be in accordance with Appendix B Schedule of Materials Testing – City of Duluth Street and Utility Projects included in these specifications. Additional testing may be performed as determined by the Engineer.

Compaction of the in-place layer shall be acceptably completed before placing material for a succeeding layer thereon. The manner of placement, layer thickness, compaction equipment, and procedure effectiveness shall be subject to approval of the Engineer. The use of heavy roller type compaction equipment shall be limited to safe pipe loading.

The maximum loose thickness of each backfill layer shall be 8 inches, except that 12 inches will be permitted for Granular Materials placed above an elevation one foot above the top of pipe, and with the provision that, by authority of the Engineer in consideration of the demonstrated capability of special type vibratory compactors, these maximums may be increased at his discretion.

Until final acceptance of the project, the Contractor shall assume full responsibility and expense for all backfill settlement and shall refill and restore the work as directed to maintain an acceptable surface condition. All additional materials required shall be furnished without additional cost to the City.

- d) Surplus and Waste Material. All surplus or waste materials remaining after completion of the backfilling operations shall be disposed of in an acceptable manner within 24 hours after completing the backfill work on each particular pipeline section. Disposal at any location within the project limits shall be as specified, or as approved by the Engineer; otherwise, disposal shall be accomplished outside the project limits at the Contractor's discretion. The backfilling and surplus or waste disposal operations shall be a part of the work required under the pipeline installation items, not as work that may be delayed until final cleanup. No additional payments will be made for disposal of surplus or waste material.

E. MEASUREMENT

MN/DOT 2451.4.A.2 Prefabricated Structures is hereby deleted and replaced with the following:

A.2 Excavation for Prefabricated Structures

No measurement will be made for excavation of prefabricated structures (utility pipes and structures), except where rock excavation is required. The Engineer will measure rock excavation for prefabricated structures by volume in accordance with the limits shown in the City of Duluth Standard Details.

MN/DOT 2451.4.B Granular Materials is hereby deleted and replaced with the following:

B1 Granular Materials for Bedding and Encasement

No measurement will be made for granular materials utilized to construct foundation bedding and backfill within the pipe encasement zone.

B2 Granular Materials for Manholes and Catch Basins

No measurement will be made for granular materials utilized to construct foundation bedding and structure backfill of manholes and catch basins.

MN/DOT 2451.4 Method of Measurement is supplemented with the following:

C1 On-Site Materials for Backfill

No measurement will be made for select grading materials utilized for backfill of prefabricated structures.

C2 Imported Materials for Backfill

The Engineer will measure imported materials for backfill above the encasement zone and below subgrade by volume in accordance with the limits shown in the City of Duluth Standard Details, when required in the Plans, or at the direction of the Engineer.

D Imported Materials for Foundation Stabilization

Where additional foundation material is required by the engineer, it will be measured by weight or volume within the limits defined by the Engineer. Unless otherwise specified, volume will be determined by vehicular measure (loose volume) at the point of delivery. Load ticket must be given to inspector upon delivery which indicates either volume (loose) or weight.

F. BASIS OF PAYMENT

All costs of excavating to foundation grade, dewatering, preparing the foundation, furnishing and installing bedding and encasement materials, placing and compacting backfill materials, and other work necessary for prosecution and completion of the work as specified, shall be included for payment as part of the specified utility and utility appurtenance Contract bid items without any direct compensation being made therefore.

MN/DOT 2451.5 Basis of Payment is hereby supplemented with the following:

No payment will be made for structure excavation or trench excavation of prefabricated structures. All costs for excavation, foundation preparation, dewatering, and separating unacceptable materials shall be considered incidental to relevant Contract bid items.

No payment will be made for granular bedding and pipe encasement materials. All costs for furnishing, placing, and compaction of bedding and encasement zone backfill materials within the pipe encasement zone shall be considered incidental to relevant Contract bid items.

No payment will be made for granular bedding and structure backfill materials for manholes or catch basins. All costs for furnishing, placing, and compaction of bedding and structure backfill materials shall be considered incidental to relevant Contract bid items.

No payment will be made for backfill with suitable on-site select grading materials; all costs for handling, placing, compaction, and disposal of unacceptable materials shall be considered incidental to relevant Contract bid items.

Payment for furnishing backfill for prefabricated structures (excluding manholes and catch basins) will be made under bid Item 2451.607 (Furnish Granular Backfill (CV)) or 2451.607 (Furnish Common Backfill (CV)) at the Contract unit price per cubic yard, which shall be compensation in full for all labor, equipment, and materials necessary to furnish backfill materials to the site and disposal of waste excavation.

All costs for placing and compacting backfill (regardless of type: select grading material, common or granular) shall be considered incidental to relevant Contract bid items.

2461 STRUCTURAL CONCRETE (VIBRATION CONTROL)

MN/DOT 2461 is supplemented with the following:

The Contractor shall protect all freshly placed concrete from vibration in accordance with the provisions of section D. (Freshly Concrete Vibration Controls) of 2105/2451 Rock Blasting and Vibration Control.

2461 STRUCTURAL CONCRETE

Revised 01-04-19 ~~SP2018-156~~: MN/DOT 2461 is hereby supplemented as noted in Appendix E – “Supplemental Concrete Specifications” of these Construction Standards.

2462 PRECAST CONCRETE

Revised 12-08-17

SP2018-157: MN/DOT 2462 is hereby supplemented as noted in Appendix E – “Supplemental Concrete Specifications” of these Construction Standards.

2472 METAL REINFORCEMENT

Revised 08-09-18

SP2018-158.1: MN/DOT 2472 is hereby supplemented as noted in Appendix E – “Supplemental Concrete Specifications” of these Construction Standards.

2502 SUBSURFACE DRAINS

Subsurface drain construction shall be performed in accordance with the provisions of MN/DOT 2502, the detailed drawing in the Contract Drawings, and the following:

4-inch or 6-inch perforated Poly-Vinyl Chloride (PVC) Sewer Pipe, SDR 35, ASTM D 3034 shall be used. Type I geotextile conforming to MN/DOT 3733 shall be used.

Payment for drain pipe will be made under the bid items listed in MN/DOT 2502 at the Contract unit price per foot, which shall be compensation in full for all costs of furnishing and installing the pipe complete in place as specified including excavation, bedding, granular backfill, geotextile, fittings, adapters, connection to existing pipe, and connection to storm structures.

2503 CONNECT TO EXISTING SEWERS

MN/DOT 2503 is supplemented with the following:

This work consists of constructing connections into existing sanitary sewer and storm sewer in accordance with the applicable MN/DOT Standard Specifications.

Measurement will be made by the number of connections constructed as specified.

Payment will be under Item 2503.602 Connect to Existing [Sanitary or Storm] Sewer at the Contract bid price per each, which shall be compensation in full for all costs incidental thereto, including but not limited to, all materials and labor necessary to connect the proposed drainage structure to the existing sewer pipe. Any damage caused to the existing sewer pipe shall be repaired at no expense to the Department and to the satisfaction of the Engineer.

2503 PIPE SEWERS - GRAVITY

Gravity sanitary sewer and storm sewer construction and reconstruction shall be performed in accordance with the provisions of MN/DOT 2503, except as modified below:

This work shall consist of the construction of gravity sanitary and storm sewer main and building services utilizing plant fabricated pipe and other appurtenant materials, installed for conveyance of wastewater and storm water. The work includes the relocation or adjustment of existing facilities as may be specified in the Contract.

All references to Specifications of MN/DOT, AASHTO, ASTM, ANSI, AWWA, etc. shall mean the latest published edition or supplement available on the date of advertisement for bids.

A. Materials

1. General Requirements

All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade and other details indicated in the Contract. Unless otherwise indicated, all required material shall be furnished by the Contractor. If any options are provided for, as to type, grade or design of the material, the choice shall be limited as may be stipulated in the Contract Drawings or Specifications.

All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Contract Drawings. Otherwise, the City may require advance approval of material suppliers, product design, or other unspecified details as it deems desirable for maintaining adopted standards.

2. Reinforced Concrete Pipe and Fittings

Reinforced concrete pipe, fittings, and specials shall conform to the requirements of MN/DOT 3236 and Standard Plate 3000 for the type, size and strength class specified. Rubber O-ring gasket joints conforming to Standard Plate 3006 shall be used.

3. Poly-Vinyl Chloride Pipe and Fittings

Smooth-walled poly-vinyl chloride pipe and fittings shall conform to the requirements of ASTM D-3034 for the size, standard dimension ratio (SDR), and strength requirements indicated on the Contract Drawings, Specifications, and Special Provisions. Unless otherwise specified, all pipe and fittings shall be SDR 35 and connections shall be push-on with elastomeric gasketed joints which are bonded to the inner wall of the gasket recess of the bell socket. Schedule 40 pipe with glued joints shall not be used.

4. Corrugated Polyethylene Pipe

This work shall consist of furnishing and installing 12-inch to 60-inch diameter dual-wall corrugated polyethylene pipe and fittings in accordance with the Contract Drawings, MN/DOT 3247, AASHTO M294 Type S, Section 12 of the AASHTO LRFD Bridge Design Specifications and the following:

Corrugated polyethylene pipe and fittings shall be manufactured from high density polyethylene (HDPE) virgin compounds. Clean reworked HDPE materials from the manufacturer's own production may be used by the manufacturer of HDPE pipe, provided that the pipe and fittings produced meet all requirements of these Special Provisions and in AASHTO M294, Type S and Section 12 of the AASHTO LRFD Bridge Design Specifications. The polyethylene compounds shall conform to the requirements of ASTM D 3350 Cell Class 435400C. Pipe shall be new or stored for a period of time that does not exceed the manufacturer's recommended maximum period of exposure, regardless of the method of storage.

Pipe couplings shall meet the watertight performance requirements of ASTM 2306. Watertight couplings must be capable of meeting a 10.8 psi laboratory test per ASTM 3212 and utilize a bell and spigot design with a gasket meeting the requirements of ASTM F 477.

Wall thickness shall be the thickness of the inner liner measured between corrugation valleys of the outer rib wall. The wall thickness shall equal or exceed the minimum wall thickness values in Table 1.

The pipe stiffness shall be determined in accordance with AASHTO M294 at 5 percent deflection. The average pipe stiffness shall equal or exceed the minimum pipe stiffness value for each size of pipe listed in Table 1.

TABLE 2503-1						
DUAL WALL CORRUGATED POLYETHYLENE PIPE (1)						
NOMINAL DIAMETER (IN.)						
Properties	12	15	18	24	30	36
Min. I.D. (in.)	11.8	14.8	17.7	23.6	29.5	35.5
Max. O.D. (in.)	14.7	18.0	21.5	28.7	36.4	42.5
Min. Wall Area (in. ² /ft.)	1.50	1.91	2.34	3.14	3.92	4.50
Min. C (in.)	0.35	0.45	0.50	0.65	0.75	0.90
Min. I (in. ⁴ /in.)	.024	.053	.062	.116	.163	.222
Min. Pipe Stiffness (psi)	46	42	40	34	28	22
Min. Wall Thickness (in.)	.035	.035	.050	.050	.080	.100

Table 2503-1 Notes:

(1) Pipe shall be on the current MN/DOT Approved/Qualified Products List.

5. Service Lateral Connections to Sewer Main Service lateral connections to gravity sewer main shall be with watertight fittings manufactured for the intended purpose. For tap service connections, the diameter of the service lateral pipe shall be not more the two-thirds of the diameter of the sewer main, except that a 6" service lateral pipe may be tapped and connected to an 8" sewer main.

Refer to Table 2503-2 Service Lateral Connections below for summary of acceptable connection types. The following is a current list of acceptable products:

- New PVC Wye – Manufactured wye fittings meeting the requirements of Section A.3 Poly-Vinyl Chloride Pipe and Fittings listed above.
- Epoxy Saddle – PVC sewer tap saddles inserted into the core drill hole (tap) and attached on the sewer main with two-part exothermic epoxy. Predco by Innovative Sewer Connections or approved equal.
- Compression Insert – A PVC stub/hub with compression gasket inserted into a core drill hole (tap) in the sewer main wall. Inserta Tee by ADS, Inc., QwikSeal by Fernco, Inc., or approved equal. Flexible tap saddles are NOT acceptable.
- New HDPE Wye – Manufactured wye fittings meeting the requirements of Section A.4 Corrugated Polyethylene Pipe listed above. ADS, Inc., Prinsco, Inc., or approved equal.
- Water Stop – Rubber gasket placed on pipe exterior and embedded in the non-shrink grout fill in between the pipe and the manhole or catch basin structure. ADS, Inc., Press-Seal, Inc. or approved equal.
- Watertight Boot – A rubber boot insert is either cast into the concrete structure or field installed in a core drill hole held in place by stainless steel compression band. Refer to Section 2506 Manholes and Catch basins found elsewhere is this standard. A-Lok Products, Inc., Kor-N-Seal by NPC, Inc., Direct Drive by Press-Seal, Inc. or approved equal.

Table 2503-2 Service Lateral Connections		
Service Lateral	Sewer Main Type	Connection Type
New or Replacement	New PVC	New PVC Wye
New	Existing PVC	Core Drill w/Epoxy Saddle or New PVC Wye
Replacement	Existing PVC	Existing Wye (1) or New PVC Wye
New	Existing Vitrified Clay	Core Drill w/Epoxy Saddle or New PVC Wye
Replacement	Existing Vitrified Clay	Existing Wye (1) or Core Drill w/Epoxy Saddle or New PVC Wye
New	Concrete Pipe	Core Drill w/Compression Insert or Core Drill w/Epoxy Saddle
Replacement	Concrete Pipe	Existing Wye (1) or Core Drill w/Compression Insert or Core Drill w/Epoxy Saddle
New	Existing Brick	Core Drill w/Compression Insert or Core Drill w/Epoxy Saddle
Replacement	Existing Brick	Existing Wye (1) or Core Drill w/Compression Insert or Core Drill w/Epoxy Saddle
New	Existing CIPP lined	Epoxy Saddle directly to CIPP Liner (2)
New	Dual Wall Corrugated HDPE	Core Drill w/Compression Insert or New HDPE Wye
Replacement	Dual Wall Corrugated HDPE	Existing Wye (1) or Core Drill w/Compression Insert or New HDPE Wye
Replacement	Existing CIPP lined	Epoxy Saddle directly to CIPP Liner (2)(3)
Replacement	Brick or Concrete MH/CB	Core Drill w/Watertight Boot per Section 2506 or Non-shrink grout w/Water Stop pipe collar
New	Brick or Concrete MH/CB	Core Drill w/Watertight Boot per Section 2506

Table 2503-2 Notes:

- (1) The existing wye will not be acceptable if a water-tight connection cannot be provided.
- (2) Remove portion of the host pipe to allow tap saddle to connect directly to CIPP liner.
- (3) If the existing service opening in the CIPP liner exceeds epoxy saddle tap dimensions, patch the existing service opening with CIPP liner, cure the CIPP patch, and cut new service opening for epoxy saddle tap to manufacturer's recommendations.

6. Flexible Couplings

Flexible couplings and adapters shall be made from elastomeric polyvinyl chloride. Couplings shall be resistant to chemicals, ultraviolet rays, fungus growth, normal sewer

gases and unaffected by soil conditions. Couplings shall be water tight. Couplings shall be attached to pipe utilizing stainless steel bands.

B. Construction Requirements

1. General Provisions

Requirements for excavation, preparing trench, backfilling and restoration are contained in 2451 EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES of these specifications and State of Minnesota Department of Transportation "Standard Specifications for Construction", and shall govern the execution of work where the specifications therein are not in conflict with more specific requirements contained in this section, the Contract Drawings or the Special Provisions.

2. Handling and Inspection

Proper and adequate implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Unloading, distribution and storage of pipe and appurtenant materials on the job site shall be as approved by the Engineer. All materials shall be handled carefully, as to prevent damage and avoid jolting contact, dropping, or dumping.

Before being lowered into laying position, the Contractor shall make a thorough visual inspection of each pipe section and appurtenant units to detect damage or unsound conditions that may need corrective action or be cause for rejection. Inspection procedure shall be as approved by the Engineer, with special methods being required as he deems necessary to investigate suspected defects more definitely. The Contractor shall inform the Engineer of any defects discovered and the Engineer will prescribe the required corrective actions or order rejection.

Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.

Store pipe on level surface. Pipe may be placed in pyramidal stacks provided the number of courses recommended by manufacturer is followed and pipe is chocked on each side to prevent roll out of the layers.

Do not dump pipe from conveyance. Unload pipe with ropes and skids or with mobile unloading equipment. Use wide slings for hoisting large pipe with boom trucks, cranes or lifts. Reinforced web slings are acceptable; chains, wire ropes or fiber ropes are not acceptable slings. Use of hooks for unloading is also unacceptable.

3. Pipe Laying Operations

Trench excavation and bedding preparations shall proceed ahead of pipe placement as will permit proper laying and joining of the units at the prescribed line and grade.

The bedding shall provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than would be adequate. Unless otherwise permitted by the Engineer, bell and spigot pipe shall be laid with the bell ends facing upgrade and the laying shall start at the downgrade end and proceed upgrade.

As each length of pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. All pipe and fitting joints shall fit tightly and be fully closed. The pipe shall be secured in place with backfill material to mid-point of pipe, and backfilled to 1 foot over the top of the pipe as specified in 2451 EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES and as shown on the standard details and the contract drawings.

4. Pipes to be Cleaned

The interior of all pipes shall be carefully freed from all dirt, stones, sand silt, mud, concrete and superfluous material of every description as the work progresses. If, in the opinion of the Engineer, the pipe contains an excess of material, the pipe shall be cleaned by the Contractor at no additional expense to the Owner.

5. Locating Wire

Locating wire shall be installed in accordance with 2503/2504 LOCATING WIRE FOR WATER AND SEWER of these specifications and the Standard Details and the Special Provisions.

6. Inside Drops

Where a sanitary sewer main line connects to a manhole more than 2 feet above the invert of the outgoing sewer, the connection shall be made by means of an Inside Drop Connection installed per the Standard Details. Outside drops shall not be used except where approved by the City Engineer.

7. PVC Sewer Service Pipe

Sewer service connections shall be installed as provided for in the contract and as may be directed by the Engineer. The sewer service connections and pipelines shall be installed in conformance with all applicable requirements of the main sewer installation. The Engineer, with the assistance of the Contractor, shall keep accurate records of all service installations as to the type, location, and elevation at the point of connection (wye), property line and termination, etc. The service installation shall not be backfilled until all required information has been obtained and recorded. Unless otherwise specified, service pipe shall be installed at right angles to the main sewer and at a straight line and grade to the property line. The standard and minimum grade shall be a uniform rise of 1 inch in 4 feet (2%) for sanitary service lines. Pipe bends shall be provided as necessary to bring the service lines to the proper location and grade. Pipe bends shall not exceed 22-½ degrees without approval of the Engineer.

All wyes, tees or the end of lateral service lines shall be closed with a stopper until all testing has been completed. Plugs/caps shall be tested against with the maximum air pressure to be used in testing.

All sanitary sewer service pipes must be insulated if the depth of cover is 6'-0" or less.

PVC sewer service pipe for existing private building services shall match the size of the existing sewer service, typically 6". In no case shall the sewer pipe reduce in size between the building and the sewer main. Four-inch service pipe may be used in new developments with new sewer main and new sewer services for residential homes. All service pipe installation shall meet the requirement of the State of Minnesota Plumbing Code.

8. Continuous Sewer Service

The Contractor shall provide adequate equipment and facilities to provide bypass pumping for all elements of work requiring interruption to flow in the sanitary sewer. Provide backup or standby capabilities satisfactory to the City. The Contractor shall coordinate work activities so that bypass pumping will not be necessary during or immediately after rain events. The Contractor shall be responsible for damages to private or public property due to sewer backup while controlling sewage flow.

Under no circumstances will bypassing of untreated wastewater to any storm drainage facility or surface water course be allowed.

All costs for flow control, temporary pumping, etc., shall be inclusive to the unit price bid for sanitary sewer.

9. Dewatering of Trench

Dewatering of the trench shall be considered incidental work for which no separate payment will be authorized.

10. Flexible Couplings

Flexible couplings and adapters shall be used to connect new pipe to existing PVC or clay pipes.

11. Bulkheads

All pipe and fitting ends left open for future connection shall be bulk-headed with prefabricated caps of the same material as the pipe material. They shall be installed with watertight seals as required for the pipeline joints. Plugs/caps shall be tested against with the maximum air pressure to be used in testing.

12. Infiltration

The infiltration shall not exceed 50 gallons per inch diameter of pipe per mile per day.

13. Television Inspection

After the sewer is completed, the City may inspect all or any portion of the sewer with closed-circuit television. The Contractor shall be responsible for leaving the sewer in a clean condition for televising.

14. Air Test

All sanitary sewer lines, including service connections, shall be watertight and shall be tested for excessive leakage upon completion and before connections are made to the service by others. Each test section of the sewer shall be subjected to exfiltration testing by air test method as described below and at the Contractor's option. The requirements set forth for maximum leakage shall be met as a condition for acceptance of the sewer section represented by the test. The sewer pipe section under test shall be clean at the time of testing but the pipe may be wetted. Pneumatic balls shall be used to plug the pipe ends at manholes. Low pressure air shall be introduced into the plugged line until the internal air pressure reaches 27.58 kPa (4.0 psi) greater than the average back pressure of any ground water pressure that may submerge the pipe. For the purpose of air testing, the back pressure (psi) attributed to ground water shall be determined based on the difference in height (feet) of the average pipe invert elevation and the anticipated ground water elevation, times a factor of **0.4335 psi per foot**. At least two minutes shall be allowed for the air temperature to stabilize before readings are taken and the timing started. During this time the Contractor shall check all plugs with soap solution to detect plug leakage. If plugs are found to leak, air shall be bled off, the plugs shall be re-tightened, and the air shall be reintroduced into the line.

The sewer section under test will be accepted as having passed the air leakage test if it does not lose air at a rate to cause the pressure to drop from 24.82 to 20.68 kPa (3.6 to 3.0 psi) in less time than one-half minute per one inch in diameter of the pipe tested.

All testing shall be performed by the Contractor without any direct compensation being made therefore, and the Contractor shall furnish all necessary equipment and materials, including plugs and standpipes as required.

15. Deflection Testing

Deflection testing shall be performed by the Contractor using a nine-point mandrel approved by the Engineer. The ball or mandrel shall have a minimum diameter equal to 95% of the actual inside diameter of the pipe.

Mandrel testing shall be done no less than thirty (30) days after installation or upon completion of construction of the roadway to the finished subgrade, whichever occurs first. The mandrel must be pulled through the pipe by non-mechanical means. Pipe through which the mandrel does not pass will be considered unacceptable. New pipe or deformed pipe which is not damaged shall be re-laid. The re-laid pipe shall be retested for deflection after no less than five (5) calendar days.

Table 2503-3		
Sanitary Sewer Pipe and Mandrel Diameter		
Pipe Diameter, Nominal (inches)	Pipe Diameter, Actual, SDR 35 (inches)	Mandrel Diameter (inches)
4	3.895	3.60
6	5.742	5.45
8	7.665	7.28
10	9.563	9.08
12	11.361	10.79
15	13.898	13.20
18	16.976	16.13
21	20.004	19.00
24	22.48	21.36
27	25.327	24.06
30	29.132	27.68
36	34.869	33.13

16. Electrical Continuity Test

The Contractor shall perform a continuity test on all tracer wire after installation of pipe. If the test shows no continuity, the Contractor shall find and repair the broken tracer wire. Pipe that fails to meet continuity requirements above will be considered unacceptable and no payment will be made.

C. Basis of Measurement and Payment

1. All payment for Pipe Sewers- Gravity and related items within this section shall include all incidental work specified under 2451 EXCAVATION, BACKFILL AND COMPACTION FOR UTILITIES including backfill with suitable onsite materials where specified.

2. Sanitary Sewer or Storm Sewer

Measurement for Pipe Sewers – Gravity shall be per lineal foot of the specified diameter and material installed. Payment shall be made for Pipe Sewers – Gravity at the Contract unit bid price for the specified diameter and material installed. Payment for pipe sewer-gravity shall include, in addition to the Basis of Payment in 2503.5, excavation, bedding, encasement materials to 1 foot over the pipe, adapters and construction joints, placing and compacting backfill above encasement zone, all cleaning and testing, and other work necessary to complete the work.

3. PVC Wye

Measurement will be made by the number of each size PVC wye furnished and installed as specified.

Payment for wyes of each size will be made under item 2503.602 ((size main)" X (service size)" PVC Wye) at the Contract price per each, which shall be compensation in full for all costs of furnishing and installing the wye complete in place as specified.

4. Connect Sewer Service

This work shall consist of furnishing and installing a connection to a Pipe Sewer complete in place including all fitting, elbows, adapters, etc. from the center line of the pipe sewer to 4 feet beyond the main in accordance with the applicable provisions of MN/DOT 2503.

Measurement will be made by the number of each sanitary or storm sewer service connections furnished and installed as specified.

Payment for each connection will be made under Item 2503.602 (Connect Sewer Service), at the Contract price per each, which shall be compensation in full for all costs of furnishing and installing the connection complete in place as specified.

5. PVC Sewer Service Pipe

This work shall consist of furnishing and installing PVC Sewer Pipe (SDR 35) complete in place including fittings, adapters, and construction joints from 4 feet beyond the wall of the pipe sewer to a termination point or connection to an existing service as the Inspector designates in accordance with the applicable provisions of MN/DOT 2503.

Measurement will be made by length along the line of the sewer service pipe to the nearest 0.5 feet. Payment for sewer service pipe will be made under Item 2503.603, ((size)" PVC Sewer Service Pipe), at the Contract price per foot, which shall be compensation in full for all costs of furnishing and installing the sewer service pipe complete in place as specified including, but not limited to, excavation, bedding, encasement materials, placing and compacting backfill and other work necessary to complete the work.

6. Construct Inside Drop

This work shall consist of furnishing and installing an Inside Drop Connection in accordance with the Standard Details, Contract Drawings and Special Provisions. Inside Drop Connections will be measured separately by the number of complete units installed, in addition to measured Contract pay items under MN/DOT 2503 and 2506. Payment for inside drop connections will be made under Item 2503.602 (Construct Inside Drop) at the Contract bid price per each, which shall be compensation in full for all costs of furnishing and installing the inside drop connection complete in place as specified.

2503 PIPE SEWERS - PRESSURE

Pressure sanitary sewer and forcemain construction and reconstruction shall be performed in accordance with the provisions of MN/DOT 2503 except as modified below:

This work shall consist of the construction or reconstruction of pressure sanitary sewer and forcemain and building service pipelines utilizing plant fabricated pipe and other appurtenant materials, installed for conveyance of wastewater. The work includes the relocation or adjustment of existing facilities as may be specified in the Contract.

All references to Specifications of AASHTO, ASTM, ANSI, AWWA, etc. shall mean the latest published edition or supplement available on the date of advertisement for bids.

A. Materials

1. General Requirements

All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade and other details indicated in the Contract. Unless otherwise indicated, all required material shall be furnished by the Contractor. If any options are provided for, as to type, grade or design of the material, the choice shall be limited as may be stipulated in the Contract Drawings or Specifications.

All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Contract Drawings. Otherwise, the Department may require advance approval of material suppliers, product design, or other unspecified details as it deems desirable for maintaining adopted standards.

2. Ductile Iron Pipe

Ductile Iron Pipe shall conform to the latest requirements of ANSI/AWWA C151/A-21.51. In addition, the pipe shall comply with the following supplementary provisions:

- a. All ductile iron pipe shall meet all the requirements listed under 2504 Water Main except as specified below or as specified in the project Special Provisions.
- b. All buried pipe shall be furnished with push-on type joints conforming to ANSI/AWWA C111/A-21.11 unless specified otherwise in the Special Provisions or shown on the contract drawing.
- c. When specified in the Special Provisions or shown on the Contract Drawings, joints shall be boltless, flexible, push-on restrained joint such as Flex-Ring by AMERICAN, or TR Flex by US PIPE. Field adaptable restrained joints may be provided through the use of Field Flex-Ring restraints by AMERICAN.
- d. Where shown on the Contract Drawings, flange joints shall be provided. Flanges shall be standard AWWA C115/A21.15Ib threaded on flanges for 250 psi operating pressure. Bolt on flanges such as Uni-flange or Mega-flange may not be substituted for flanged pipe.
- e. All pipe shall be furnished in 18 or 20-foot nominal lengths.
- f. Minimum ANSI thickness class furnished shall be Class 52 for all pipe through 16" pipe. For pipes larger than 16" the appropriate class shall be called out in the Special Provisions. Above grade flanged pipe shall be class 53.
- g. Pipe shall be provided with provisions to maintain electrical continuity for thawing and locating purposes.
- h. A Certificate of Compliance shall be furnished stating that the materials furnished have been tested and are in compliance with the requirements of this Specification.

3. Ductile Iron Fittings

Fittings shall conform to the latest requirements of ANSI/AWWA C110/A-21.10-08 (Gray Iron and Ductile Iron Fittings), or ANSI/AWWA C153/A-21.53 (Ductile Iron Compact Fittings), all with ductile iron glands and cement lining.

- a. Buried fittings shall be mechanical joint with rubber gaskets.

- b. Exposed fittings shall be flanged conforming to ANSI B16.1, Class 125 and have full face gaskets.
 - c. Exposed fittings shall be shop primed for painting.
 - d. Fittings shall be provided with provisions to maintain electrical continuity.
 - e. Fittings shall be manufactured in North America or preapproved by the City Chief Engineer of Utilities.
 - f. Mechanical joint bolts shall be as specified elsewhere in this section
 - g. When specified in the Special Provisions or shown on the Contract Drawings, buried fittings shall be boltless, flexible, push-on restrained joint fittings such as Flex-Ring by AMERICAN, or TR Flex by US PIPE. Field adaptable restrained joints may be provided through the use of Field Flex-Ring restraints by AMERICAN.
4. HDPE Pipe and Fittings
- a. HDPE pressure sewer and forcemain pipe shall meet all the requirements listed under 2504 Water Main except as specified below or as specified the project Special Provisions.
 - b. Couplings used for pressure sewer force main and services (4 inches and larger) shall be electrofusion type. Couplings used for services (3 inches and smaller) shall be electrofusion or socket fused type.
 - c. Pipe shall be new or stored for a period of time that does not exceed the manufacturer's recommended maximum period of exposure, regardless of the method of storage.
 - d. The DR number and pressure rating specified above shall be considered a minimum. Provide stronger class pipe if required by loads imposed by directional drilling pulling operation or pipe bursting.
 - e. Shop drawings for HDPE pipe must specify minimum allowable pipe deflection radius.
5. Stainless Steel Pipe
- Stainless steel pipe materials shall meet the requirements of ASTM A53 schedule 40 with threaded joints meeting the requirements of ASTM A865. All couplings and fittings shall be the same material as the host pipe.
- All steel shall be made in North America.** The Contractor shall provide certification of steel origin to Engineer prior to installation.
6. Transition Couplings
- Cast transition couplings shall be as specified under 2504 Water Main or as specified in the project Special Provisions.
7. Gate Valves
- Gate valves shall be manufactured and furnished in accordance with an approved pattern and shall conform to the requirements of AWWA C509 or C515 for resilient seated gate valves, and all gate valves must meet such supplementary requirements as may be stipulated in the Contract Drawings or Special Provisions and the provisions hereof.

Unless otherwise specified, the valves furnished shall comply with the following supplementary requirements:

- a. All gate valves shall have a working pressure rating of 250 psi.
- b. Gate valves shall be solid disc with resilient seating.
- c. The wedge shall be ductile iron and fully encapsulated with EPDM rubber.
- d. Valves shall have a two-inch square operating nut opening counter-clockwise.
- e. All valves shall be of the non-rising stem type.
- f. All valves shall be furnished with triple O-Ring stem seals. The O-Rings above the thrust collar shall be fully replaceable with the valve "open" and under full pressure. The third O-ring shall be provided below the thrust collar.
- g. The exterior of the valve shall be supplied with a fusion bonded epoxy coating.
- h. All buried gate valves shall be furnished with extension stems which extend to within one foot of the finished grade elevation. The extension stem shall have a 2-inch operating nut and be mechanically connected to the valve operator.
- i. All valves within structures or vaults shall have extension stems that extend to within 6 inches of the top of slab or other designated elevations shown on the drawings. Stem guides shall be provided for all valves within wet wells, vaults or other inaccessible locations.
- j. Gate valves shall be manufactured by American Flow Control, Clow, Dezurik,, Mueller, or equal. All "or equal" valves shall be preapproved by the City Chief Engineer for Utilities prior to bidding. All valves shall be made in North America. Shop drawings for gate valves shall include a statement attesting to their country of origin.
- k. Gate valve box adapters shall be ¼ inch steel adapter and ¾ inch neoprene gasket. The steel adapter shall be coated with polyurethane protective coating. Adapters shall be manufactured by Adaptor, Inc.
- l. Buried valves shall have mechanical joint ends or fusible HDPE stubs of the same pipe diameter and SDR as the main. MJ joints shall be complete with gasket, gland, and bolts.
- m. Exposed valves shall have flanged ends conforming to ANSI B16.1, Class 125 with full face gaskets.
- n. Bolts or valve flange shall be provided with means for preventing the bolt from slipping in the slotted holes.
- o. All exposed bolts on the valve, including stuff box and bonnet bolts shall be 316 stainless steel.
- p. Bolts for flanged valves exposed to wastewater shall be 316 stainless steel.
- q. Mechanical joint bolts shall be as specified in the Water Main section (2504).
- r. 6 ounce zinc anode caps conforming to ASTM B-418 shall be installed on the bolts on all mechanical joint fittings.

- s. A 12-pound (minimum) bare zinc anode shall be attached to MJ bolt for all valves as shown in the Standard Detail W-18.

8. Valve Boxes

Valve Boxes shall be 5 1/4" cast iron shaft, 'three-piece' screw-type, consisting of the following parts:

Cover	Stay-put type, " SEWER " cast thereon, with solid edges (no grooves or flutes on edge)
Top Section	26" or 26.5" length
Extension Section	30" length (effective 24" length)
Bottom Section	36" length
Base	#6 Round Base

All parts must be interchangeable with Bingham and Taylor #4906 and Tyler #6860. Valve box assemblies shall be manufactured in Northern America or preapproved by the Engineer.

9. Check Valves

Check valves shall be provided with cast iron or ductile body with top opening for disc replacement without requiring valve body removal. Valve body shall provide a clear waterway in the fully opened position. Trip shall be grade A bronze. Valves shall be furnished with outside lever and weight to assist rapid closure. Disc shall be of cast or ductile iron construction, bronze-mounted. Valves shall be furnished with flanged ends conforming to ANSI B16.1, Class 125. Valves shall meet the general requirements of AWWA C508. Check valves shall be American Flow Control, Clow, Henry Pratt or pre-approved equal.

10. Ball Valves

Ball valves up to 2-inches shall be bronze or stainless steel one piece body, chrome plated brass ball, Teflon seats and stuffing box ring, lever handle, solder or threaded ends. PVC ball valves are not acceptable.

11. Pressure Gauges

Pressure gauges shall be 2 ½ inch minimum diameter, silicone filled, stainless steel case and base, and spiral tube with a polycarbonated lens and ¼ NPT male center back connection. The gauge shall be rated for a maximum pressure of twice the rated pump capacity unless called for otherwise in the Special Provisions or on the Plans.

12. Pressure Sewer Services and Fittings

- Pressure sewer services shall conform to the same requirements for HDPE pipe and fittings.
- Tapping Tees with Electrofusion Saddle shall be as specified under 2504 Water Main or as specified in the project Special Provisions.

- c. Curb Stops shall be quarter turn check, Minneapolis Pattern thread top, with AWWA standard flared copper pipe connections on both ends. Curb stops shall be Mueller B-25154N, Ford B22 series, or approved equal.
- d. Curb Boxes shall be magnetized locator wire boxes as specified elsewhere shall be adjustable up and down for a minimum of 7 feet of cover.

13. Wall Sleeves and Wall Pipes

Wall sleeves and wall pipes shall conform to the requirements of the process piping as indicated on the contract drawings and as specified as follows:

Cast Iron: ASTM A48, Class 30B

Ductile Iron: ASTM A536, Grade 60-40-18

Mechanical Joint: ANSI/AWWA C111/A21.11

Integral cast or welded intermediate wall collar

Wall pipes shall be used at all locations where pipes penetrate new cast in place concrete walls.

15. Modular Rubber Seals

Modular rubber wall seal shall be mechanical type, consisting of inter-locking synthetic rubber links. The elastomeric element shall be sized and selected per manufacturer's recommendation and have the following properties as designated:

Standard service application (-40 degrees F to 250 degrees F) EPDM:

ASTM D2000 M3BA510. - Hydrocarbon service application (-40 degrees F to 210 degrees F) Nitrile:

ASTM D2000 M1BF510 - High temperature or fire seal application (-67 degrees F to 400 degrees F)

Silicone: ASTM D2000 M1GE505

Assembly of synthetic rubber links connected with 316 stainless steel bolts. When the bolts are tightened, pressure plates shall compress the rubber links to fill the annular space between the pipe and the wall sleeve to form a watertight seal.

Modular rubber wall seals shall be used where pipes penetrate existing concrete walls or precast walls and as otherwise indicated on the contract drawings. Use of modular rubber seals in any other locations shall require written approval of the Engineer.

Modular rubber wall seal shall be Link-Seal, manufactured by Thunderline Corporation or equal.

16. Pipe Supports and Pipe Hangers

Pipe supports bearing on concrete surfaces shall consist of a base flange, support rod with threaded ends for height adjustment and a saddle type or stanchion type support. Provide floor-mounted type support stands where wall or ceiling mount are not feasible and maintenance access will not be interrupted.

Wall mounted support brackets shall be constructed of angle iron and include a u-bolt attachment, roller or pipe saddle above the bracket. Wall mounted pipe support brackets are permitted the pipe is within 2 feet of the wall.

Ceiling installed hangers and supports shall conform to the American Standard Code for Pressure Piping, ANSI B31.1.

All pipe supports installed in above ground building without the presence of wastewater shall be painted steel. All pipe supports installed below ground or in any room where exposed wastewater is present shall be 316 stainless steel.

B. Construction Requirements

1. General Provisions

Requirements for excavation, preparing trench, backfilling and restoration are contained in 2451 EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES of these specifications and State of Minnesota Department of Transportation "Standard Specifications for Construction" current edition, and shall govern the execution of work where the specifications therein are not in conflict with more specific requirements contained in this section, the Standard Details, Contact Drawings, or the Special Provisions.

All horizontal directional drilling shall be performed in accordance with (2503/2504/2505) HORIZONTAL DIRECTIONAL DRILLING of these specifications.

2. Handling and Inspection

Proper and adequate implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Unloading, distribution and storage of pipe and appurtenant materials on the job site shall be as approved by the Engineer. All materials shall be handled carefully, as will prevent damage to protective coatings, linings, and joint fittings; preclude contamination of interior areas; and avoid jolting contact, dropping, or dumping.

Before being lowered into laying position, the Contractor shall make a thorough visual inspection of each pipe section and appurtenant units to detect damage or unsound conditions that may need corrective action or be cause for rejection. Inspection procedure shall be as approved by the Engineer, with special methods being required as he deems necessary to investigate suspected defects more definitely. The Contractor shall inform the Engineer of any defects discovered and the Engineer will prescribe the required corrective actions or order rejection. Any pipe with scratches, cuts or scrapes deeper than 10% of the wall thickness shall be used unless the damaged section is cut out.

Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.

Store pipe on level surface. Pipe may be placed in pyramidal stacks provided the number of courses recommended by manufacturer is followed and pipe is chocked on each side to prevent roll out of the layers. Cover pipe ends to prevent dirt, debris, wildlife and weather from entering. HDPE pipe stored for more than 3 weeks should be covered for protection from sunlight and weather.

Do not dump pipe from conveyance. Unload pipe 12 inch (300 mm) and smaller by hand with ropes and skids. Unload pipe larger than 12 inch (300 mm) or pipe bundles with mobile unloading equipment. Use wide slings for hoisting large pipe with boom trucks, cranes or lifts. Reinforced web slings are acceptable; chains, wire ropes or fiber ropes are not acceptable slings. Use of hooks for unloading is also unacceptable.

3. Pipe Laying Operations

Trench excavation and bedding preparations shall proceed ahead of pipe placement as will permit proper placement and joining of the pipe and fittings at the prescribed grade and alignment without unnecessary hindrance. Every reasonable precaution shall be taken to prevent foreign materials from entering the pipe and fittings while they are being placed in the line. The sewer materials shall be carefully lowered into laying position by the use of suitable restraining devices. Under no circumstances shall the pipe be dropped or dumped into the trench.

At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connection, but they shall be no larger than would be adequate. No pipe material shall be laid in water nor when the trench or bedding conditions are otherwise unsuitable or improper. Unless otherwise permitted by the Engineer, bell and spigot pipe shall be laid with the bell ends facing in the direction of laying.

When placement or handling precautions prove inadequate, in the Engineer's opinion, the Contractor shall provide and install suitable plugs or caps effectively closing the open ends of each pipe section before it is lowered into laying position, and they shall remain so covered until removal is necessary for connection of an adjoining unit.

As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted around the pipe. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is affected.

At all times when pipe laying is not in progress, including noon hour and overnight periods, all open ends of the pipe line shall be closed by watertight plugs or other means approved by the Engineer. If water is present in the trench, the seals shall remain in place until the trench is pumped completely dry.

4. Aligning and Fitting of Pipe

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth square-cut end. Cast iron or ductile iron pipe shall be cut with approved mechanical cutters. The electric-arc cutting method, using carbon or steel rod, will be approved for use on the larger size pipe where mechanical cutters are not available. Flame cutting will not be allowed under any conditions. All rough edges shall be removed from the cut ends of

pipe and, where rubber gasket joints are used, the outer edge shall be rounded or beveled by grinding or filing to produce a smooth fit.

When necessary to deflect the pipe from a straight line either in the vertical or horizontal plane to avoid obstructions, or produce a long radius curve, the amount of deflection allowed at each joint shall not exceed the allowable limits established in the following tables:

MAXIMUM PERMISSIBLE DEFLECTION IN LAYING PUSH-ON JOINT FOR DUCTILE IRON PIPE					
Pipe Size	Max. Angle	MAX. OFFSET PER PIPE		Approx. Radius	
		18' length	20' length	18' length	20' length
3" to 12"	5°	19"	21"	205'	230'
16" to 24"	3°	11"	12"	340'	380'
30" to 36"	2°	7.5"	8"	510'	570'

MAXIMUM PERMISSIBLE DEFLECTION IN LAYING MECHANICAL JOINT FOR DUCTILE IRON PIPE			
Pipe Size	Max. Angle	MAX. OFFSET PER PIPE	
		18' length	20' length
4"	8.3°	31"	35"
6"	7.1°	27"	30"
8" to 12"	5.3°	20"	22"
16"	3.5°	13"	15"
18" & 20"	3.0°	11"	12"
24" & 30"	2.3°	9"	10"
36"	2.0°	8"	9"

Connection and assembly of joints shall be accomplished during the setting, aligning and fitting operations, in accordance with the provisions of this specification to the extent that the jointing requirements will permit.

HDPE pipe may be deflected at a maximum radius of 25 times the nominal pipe OD. When a fitting or connection is present, the maximum radius shall be 100 times the nominal pipe OD.

5. Blocking and Anchoring of Ductile Iron Pipe

All plugs, caps, tees, bends and other thrust points shall be provided with reaction backing, or movement shall be prevented by attachment of suitable restraining devices, in accordance with the requirements listed below and the Standard Details.

- a. All horizontal bends, plugs, caps and branch tees shall be provided with concrete buttresses.
- b. For 16" and smaller diameter, precast concrete blocks may be used in lieu of cast in place concrete when used in conjunction with "Mega-lug" joint restraints. Precast

blocks shall be stepped out as installed to provide similar surface area as the cast in place thrust blocks. Use of "Mega-lug" restraints only without blocking is only acceptable if adjacent pipe is restrained as described below.

- c. All vertical bends exceeding 11-1/4 degrees deflection shall be provided with concrete buttress blocking at the low points with metal tie rod or strapping restraints at the high points.
- d. Offset bends made with standard offset fittings need not be strapped or buttressed, unless installed in combination with another fitting.

All necessary fittings, bands, tie rods, nuts, and washers, and all labor and excavation required for installation of reaction restraints shall be furnished by the Contractor at his expense and without direct compensation.

Concrete blocking shall be at least 2 inches nominal thickness.

Concrete buttresses shall be poured against firm, undisturbed ground and shall be formed in such a way that the joints will be kept free of concrete and remain accessible for repairs. The concrete mix used in buttress construction shall meet the requirements for Type 3 Grade B of MN/DOT 2461. Buttress dimensions shall be as indicated on the Standard Detail Drawing.

All metal parts of tie rod or strap type restraints shall be galvanized.

"Megalug" joint restraints by Ebba Iron, Inc., or Uni-Flange Series 1400 "Block Buster" by Ford, may be substituted for rodding and blocking. Retainer (set screw type) glands may not be used in lieu of approved restraints or buttresses. "Megalug" and "Blockbuster" restraints may only be used on ductile iron pipe and shall not be used on any existing cast iron pipe.

When using "Megalug" type restraints in lieu of blocking, the pipe shall be restrained in each direction from the fitting a sufficient distance to prevent joint separation upstream or downstream. The minimum length of restrained pipe required shall be as shown on the contract drawings or as specified in Special Provisions. If no minimum length for restrained joints is specified, the Contractor shall submit the restrained joint calculations to the Engineer for review prior to construction or restrain a minimum of 42 feet in each direction.

6. Blocking of HDPE Pipe

All plugs, caps, tees, bends and other thrust points shall be provided with concrete blocking if there is an unrestrained joint within 42 feet of the thrust point. Blocking is not required when all joints within 42 feet are restrained.

When required, concrete blocking shall be install per the Standard Details.

7. Locating Wire

Locating (tracer) wire shall be installed on all HDPE pressure sewers, force mains and services.

8. Electrical Continuity in Ductile Iron Pipe

Provisions shall be made to insure electrical continuity between all joints, fittings, and valves. Two serrated brass wedges shall be inserted for 3 inch to 12 inch push-on joints on ductile iron pipe or cable bond may be used. Four wedges per joint shall be used for larger pipe. Continuity for mechanical joints may be provided using copper clips inserted in the gasket by the manufacturer, armored tipped gaskets, copper strap, or cable bond. Megalug joint restraints shall not be used for electrical continuity.

9. Connection and Assembly of Joints

a. General

Where rubber gasketed joints are specified, care shall be taken during the laying and setting of piping materials to insure that the units being joined have the same nominal dimension of the spigot outside diameter and the socket inside diameter. A special adaptor shall be provided to make the connection when variations in nominal dimension might cause unsatisfactory joint sealing.

Immediately before making the connection, the inside of the bell or socket and the outer surface of the spigot ends shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. Insertion of spigot ends into the socket or bell ends shall be accomplished in a manner that will assure proper centering and insertion to full depth. The joint seal and securing requirements shall be as prescribed below for the applicable pipe and joint type.

b. Push-On Joints

The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the ball socket. A thin film of approved gasket lubricant shall be applied to either the inside surface of the gasket or the outside surface of the spigot end, or to both. Care shall be taken while inserting the spigot end to prevent introduction of contaminants. The joint shall be completed by forcing the spigot end to the bottom of the socket by the use of suitable pry-bar or jack type equipment. Spigot ends which do not have depth marks shall be marked before assembly to insure full insertion. Field cut pipe shall be filed or ground at the spigot edge to resemble the manufacturer's fabricated detailing.

c. Mechanical Joints

The last eight inches of the outside spigot surface and the inside bell surface of each pipe and appurtenance joint shall be painted with a soap solution after being thoroughly cleaned. The gland shall then be slipped on the spigot end with the lip extension toward the socket or bell end. The rubber gasket shall be painted with soap solution and be placed on the spigot end with the thick edge toward the gland. An approved lubricant provided by the pipe manufacturer may be used in lieu of the soap solution.

After the spigot end is inserted into the socket to full depth and centered, the gasket shall be pressed into place evenly around the entire joint. After the gland is positioned behind the gasket, all bolts shall be installed and the nuts tightened

alternately to the specified torque, such as to produce equal pressure on all parts of the gland.

Unless otherwise specified, the bolts shall be tightened by means of a suitable torque-limiting wrench to within a foot-pound range of: 45 to 60 for 5/8" bolts; 75 to 90 for 3/4" bolts; 100 to 120 for 1" bolts, and 120 to 150 for 1-1/4" bolts.

6 ounce zinc anode caps conforming to ASTM B-418 shall be installed on the bolts on all mechanical joint fittings.

d. Qualifications for Joining HDPE Sewer Pipe

Before being permitted to make joints on the HDPE water main pipe, all joiners shall be qualified and successfully complete a qualification test as required in accordance with Qualifications for Joining PE Pipe, of the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe.

e. Fusion Joining of HDPE Sewer Pipe

All HDPE water main pipe and fittings shall be joined by butt fusion, socket fusion, or electrofusion procedures as specified in the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe and as specified under 2504 Water Main.

10. Pipe Support Spacing

Contractor shall provide pipe supports as necessary to adequately support exposed piping. At a minimum, one support shall be provided for every 4 feet of PVC pipe installed or one for every 10 feet of steel or ductile pipe installed, at each direction change and at each valve.

11. Pressure Gauge Installation

Pressure gauges shall be installed on each City-owned pump discharge within the valve vault or as shown on the Contract Drawings. Provide an isolation ball valve at each installation to allow for gauge removal.

12. Pressure Sewer Service Installation

Pressure sewer service facilities consisting of 1 1/4" service lines, complete with all required appurtenances, shall be installed as required by the Contract, in accordance with all pertinent requirements for main line installations together with the provisions hereof.

It shall be the responsibility of the Contractor to keep work exposed so the Engineer may obtain an accurate record of the location, depth and size of each service connection and other pertinent data such as the location of curb stops and pipe endings.

Pressure sewer service lines shall normally be installed by trenching or directional drilling and be subject to the same requirements as prescribed for the main pipeline installation, except for those which may not be pertinent or applicable. Where water service lines are installed alongside of pressure sewer services, installation shall be such as to maintain the

minimum specified clearances between pipelines and provide proper and adequate bearing for all pipes and appurtenances.

Unless otherwise specified, installation of pressure sewer service lines shall be such as to provide for not less than seven feet of cover over the top of the pipe and for not less than 18 inches of clearance between pipelines. Also, at least three inches of clearance shall be maintained in crossing over or under other structures except that 12-inches shall be maintained when crossing water mains. Where the service pipe may be exposed to freezing due to insufficient cover or exposure from other underground structures, the pipe shall be insulated as directed by the Engineer.

HDPE pressure sewer service piping shall be installed in one piece without intermediate butt fusion or electrofusion joint couplings between the tapping tee with electrofusion saddle at the pressure sewer and the curb stop. Transition couplings shall be used to connect to the curb stop.

Connection of HDPE pressure sewer service lines to the pressure sewer shall be made with an approved tapping tee with electrofusion saddle on HDPE mains.

Unless otherwise indicated, service lines shall be installed on a straight line at right angles to the pressure sewer or property lines as directed by the Engineer. Service lines shall extend for such distance beyond the curb stop as may be specified in the Contract. In the absence of specific requirements, the service line shall be terminated at the curb stop, where it shall be connected to an existing line or, in the case of undeveloped property, capped or plugged, as approved by the Engineer.

The service pipe and curb stop coupling depth shall be such as to maintain not less than the specified minimum cover and provide for a standard service box installation where practicable. Curb stop shall be set on a concrete block. The service box shall be threaded over the curb stop coupling. Service boxes shall be installed plumb and be braced effectively to remain vertical during and after completion of backfilling. The service boxes shall be brought to existing surface grade when the final grade has not been established. When the final grade has been established, the Contractor shall extend the service box to finished grade.

13. Furnish and Install Gate Valve and Box

This work shall consist of furnishing and installing a gate valve and valve box in accordance with the applicable MN/DOT Standard Specifications, the current Standard Practices and Specifications of the City of Duluth as detailed in the Plan, and the following: Prior to installation, the valve shall be cleaned of all foreign matter. A 12 pound (minimum) bare zinc anode shall be attached to MJ bolt for all valves as shown in the standard details. 6 ounce zinc anode caps conforming to ASTM B-418 shall be installed on the bolts on all mechanical joint fittings.

14. Testing Pressure Sewer and Forcemain and Service

Pressure sewer and forcemains shall be subjected to the pressure and leakage tests prescribed herein and in conformance with the pipe manufacturer's recommendations.

The Contractor shall furnish the pump, pipe connections, gauges, and measuring equipment, and shall perform the testing under the direct observation of the Engineer.

The Contractor may test each valved section, larger sections, or the entire pressure sewer or forcemain so long as the elevation differential between the highest and lowest point does not exceed 110 feet.

All air must be expelled from the pipe. A hydrostatic pressure of not less than 150 pounds per square inch, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner.

For ductile iron mains, pressure shall be maintained for a minimum duration of 2 hours. No drop in pressure will be allowed for acceptance of the main. Any defective joints, pipe, fittings, or valves revealed during the testing, or before final acceptance of the work, shall be satisfactorily corrected and the test shall be repeated until the specified requirement has been met.

For flanged pipe, no visible leakage shall be allowed during the test.

For HDPE mains, fill the main slowly ensuring fill rate does not exceed capacity of air release devices. Once air has been expelled from the system, gradually raise the pressure to 160 psi. Add makeup water as necessary to maintain this pressure as necessary for 4 hours. After 4 hour period, reduce main pressure to the 150 psi test pressure and monitor for 1 hour. Do not increase pressure or add make-up water during this one hour period. The test is passed and considered acceptable if the main pressure does not drop more than 5% (7.5 psi) during the one hour period.

The connection of pressure sewer services to HDPE pressure sewers with an electrofusion corp saddle and corporation stop or a tapping tee with electrofusion saddle shall be soap tested and tested with air and accepted if it maintains 100 psig for 5 minutes. Accepted electrofusion corp saddle or tapping tee with electrofusion saddle can then be tapped to the main and the tap or punch tee cap reinstalled. Pressure sewer pipes shall be pressure tested either jointly or separately from pressure sewer main testing. Test pressure shall be 150 psi.

15. Electrical Continuity Test

For ductile iron pipe systems, the Contractor shall perform a continuity test between hydrants or any accessible point of the backfilled system. If the test shows no continuity, the Contractor shall find and repair the broken circuit. Megalug joint restraints shall not be used for electrical continuity.

For HDPE pipe systems, the Contractor shall perform a continuity test on all tracer wire after installation of pipe. If the test shows no continuity, the Contractor shall find and repair the broken tracer wire.

Pipe that fails to meet continuity requirements above will be considered unacceptable and no payment will be made.

C. Method of Measurement

All items will be measured separately according to the Pay Item name and as detailed and defined in the Contract Drawings, Specifications, standard details or Special Provisions. Pipe will generally be designated by size (nominal diameter), strength class, kind or type, and laying conditions. Complete-in-Place items shall include all component parts thereof as described or required to complete the unit, but excluding any excesses covered by separate Pay Items.

1. Pressure Sewer, Pressure Sewer Service or Forcemain

Mainline pipe and service pipe of each kind and size will be measured separately per linear foot by the overall length along the axis of the pipeline, from beginning to end of each installation and without regard to intervening valves or specials. Terminal points of measure will be the spigot or cut end, base of hub or bell end, center of valves, intersecting centers of tee or wye branch service connections, and center of main to center of curb stop. Linear measurement of piping will include the running length of any special fitting (tees, wyes, bends, gates, etc.) installed within the line of measure between specified terminal points. No additional measurement will be made for extra pipe installed due to extra depth required for direction drilling applications.

2. Valves

Valves of each size and type will be measured separately per each as complete units, including the required valve box setting.

3. HDPE Tapping Tee with Electrofusion Saddle

HDPE tapping tee and electrofusion corp saddle of each size and type will be measured separately per each by the number of complete units installed.

4. HDPE Service Tees

This work shall consist of furnishing and installing service tees in the Pressure Sewer Pipe in accordance with the applicable provisions of MN/DOT 2503.

Measurement will be made by the number of each size tee furnished and installed as specified.

Payment for tee of each size will be made under item 2503.602 at the Contract price per each, which shall be compensation in full for all costs of furnishing and installing the tee complete in place as specified.

5. Tracer Boxes

Tracer Boxes of each type will be measured separately per each by the number of complete units installed.

6. Air Vents

Air vents of each type and size will be measured separately per each by the number of complete units installed, including the required manhole or valve box setting.

7. Access Structures

Access structures, such as Manholes and Vaults, will be measured for payment separately per each, except when included as a component part of an air vent. When applicable, measurement will be by the number of complete individual units installed of each type and design, including the required manhole or vault castings, and covers.

8. Pressure Sewer and Forcemain Fittings

All fittings for pressure sewer and forcemain installations shall be incidental to pipe installation and no measurement shall be made.

D. Basis of Payment

Payment for Pressure Sewer and Forcemain of each size and kind at the appropriate Contract prices per linear foot of installation shall be compensation in full for all costs of furnishing and installing the pipe complete in place as specified, including all costs of pipe installation as may not be specifically covered under other Contract Items. All costs of pipeline leakage testing, pipe jointing materials, dead facilities, blocking and anchorage materials, and other work necessary for installation of pipe as specified shall be included for payment as part of the pipe item, without any direct compensation being made thereafter.

Payment will be made under Item 2503.603 (size) DIP Forcemain at the contract bid price per linear foot which shall be compensation in full for all costs of furnishing and installing ductile iron forcemain between the locations shown on the Contract Drawings, including all materials, labor, equipment, ductile iron forcemain pipe, appurtenances, zinc anode caps, excavation, bedding, encasement materials, placing and compacting backfill, testing, and incidentals.

Payment will be made under Item 2503.603 (size) HDPE Pressure Sewer or Forcemain SDR 11 at the contract bid price per linear foot which shall be compensation in full for all costs of furnishing and installing HDPE pressure sewer or force main between the locations shown on the Contract Drawings, including all materials, labor, equipment, HDPE pressure sewer or forcemain pipe and fittings, appurtenances, HDPE by MJ adapters, HDPE to cast iron transition couplings, zinc anode caps, locating wire, excavation, bedding, encasement materials, placing and compacting backfill, testing and incidentals. All costs of furnishing and installing electrofusion flex restraints and concrete collars on the HDPE pressure sewer or forcemain shall be considered incidental to the main. No payment shall be made for pipe with a tracer wire that has not passed the continuity test.

Payment will be made under Item 2503.603 (size) HDPE SDR 11 Pressure Sewer Service Pipe at the Contract bid price per foot, which shall be compensation in full for all labor and equipment necessary to complete the work as described herein including excavation, bedding, encasement materials, placing and compacting backfill, and tracer wire for HDPE pressure sewer service pipe. No payment shall be made for pipe with a tracer wire that has not passed the continuity test.

Payment will be made under Item 2503.602 (size) Tapping Tee with Electrofusion Saddle at the Contract bid price per each, which shall be compensation in full for all material, labor and equipment necessary to complete the work as described herein including tapping the

pressure sewer, furnishing and installing the connection fitting on the main and butt fusing the HDPE pressure sewer service pipe to the tapping tee with electrofusion saddle.

Payment will be made under Item 2503.602 (size) Pressure Sewer Curb Stop and Box at the Contract bid price per each, which shall be compensation in full for all materials, labor and equipment necessary to install the curb box and furnish and install the curb stop and any transition fittings necessary to connect new HDPE pressure sewer service pipe to the curb stop.

Payment will be made under Item 2503.602 (size) Gate Valve and Box at the Contract bid price per each, which shall be compensation in full for all costs incidental thereto to furnish and install the gate valve and valve box complete and in place, including but not limited to the gate valve and valve box, blocking, MJ to HDPE adapters, 12 lb. bare zinc anode, zinc anode caps, and crushed stone. No additional payment will be made for valves installed where new mains are deeper than the minimum depth.

2503 CURED-IN-PLACE PIPE LINING

Provide all labor, equipment, and materials required to install and test cured-in-place pipe (CIPP) lining and appurtenances complete as shown on the Drawings and as specified herein.

A. Definition

Cured-in-place pipe lining is a trenchless rehabilitation method for buried pipelines, typically used to rehabilitate cracked, leaking, and deteriorating sewers.

B. System Description

Cured-in-place pipelining is typically installed in an inversion-type process that is inserted into the existing pipe at a manhole. The lining is a resin-impregnated flexible felt tube that is inserted into an existing pipe utilizing a free standing or truck-mounted inversion tower.

During the inversion process, the lining material is turned inside out so the tough, but smooth polyurethane side becomes the interior surface of the new pipe. Hydrostatic head or steam pressure is used to insert the liner and provide a continuous tight fitting liner after the cure process is complete.

C. Reference Standards

American Society for Testing and Materials (ASTM):

- ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials
- ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

D. Submittals

1. Product Data

- a. Shop drawings of all cured-in-place pipe lining (CIPP) materials including resin, felt, and catalysts.
- b. Engineering calculations specifying the design and required thickness for each installation that are signed and sealed by a Professional Engineer licensed in the State of Minnesota.
- c. Prior to mobilization, submit a table of all inside diameter measurements of all sewers scheduled to be lined.
- d. Detailed wet-out, storage, shipping, and installation procedures.
- e. Certified test reports that the CIPP for this Contract was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.
- f. Lining production schedule with locations, lengths and sizes.

2. Previous Work Experience

The Contractor shall submit the following information to the Engineer for review and approval before any CIPP lining work is performed:

- a. The number of years of experience installing CIPP lining.
- b. The name of the CIPP lining manufacturer and supplier for this work and previous work listed below.
- c. The Contractor shall submit a certified statement from the manufacturer that he/she is a certified and/or licensed installer of the CIPP lining.
- d. A list of municipal clients that the Contractor has performed this type of work for, including names, phone numbers, linear footage, and a description of the actual work performed. Provide a sufficient number of references to total 20,000 feet or more of lining work to date.
- e. A list of all completed CIPP lining projects within the past three years.

3. Equipment and Construction Procedures

4. Certificates of Compliance

5. Request to Sublet forms

6. Access and Site Restoration Agreements with Property Owners

E. Qualifications of the Cured-in-Place Pipe Lining Contractor

1. The Contractor performing the CIPP lining work shall be fully qualified, experienced, and equipped to complete this work expeditiously and in a satisfactory manner and shall be certified and/or licensed as an installer by the CIPP manufacturer. There shall be no exceptions to these requirements.
 - a. The Contractor shall have successfully installed a minimum of 20,000 feet of the proposed liner as documented by verifiable references.

- b. The proposed Superintendent shall have successfully installed a minimum of 10,000 feet of the proposed liner as supported by Owner references.
 2. The Contractor shall also be capable of providing crews as needed to complete the work without undue delay and shall begin work within 10 days from the authorized Notice to Proceed.
 3. The Owner shall approve or disapprove the Contractor and/or manufacturer based on the submitted information and a follow up interview, if necessary.
 4. Submit references for any subcontractor that may be used on site.
- F. Delivery, Storage, and Handling
 1. Care shall be taken in shipping, handling, and storage to avoid damaging the liner. Extra care shall be taken during cold weather construction. Any liner damaged in shipment shall be replaced as directed by the Engineer.
 2. Any liner showing a split or tear, or which has received a blow that may have caused damage, even though damage may not be visible, shall be marked as rejected and removed at once from the job site.
 3. The liner shall be maintained at a proper temperature in refrigerated facilities to prevent premature curing at all times prior to installation. The liner shall be protected from UV light prior to installation. Any liner showing evidence of premature curing will be rejected for use and will be removed from the site immediately.
- G. Guarantee
 1. All CIPP lining placed shall be guaranteed by the Contractor and manufacturer for a period of one year from the date of final acceptance. During this period, all serious defects discovered in the CIPP lining, as determined by the Owner's Engineer, shall be removed and replaced in a satisfactory manner by the Contractor at no cost to the Owner. The Owner may conduct an independent television inspection, at his own expense, of the lining work prior to the completion of the one year guarantee period.
- H. Quality Assurance
 1. All liner to be installed under this Contract may be inspected at the plant for compliance with this Section by the Engineer or an independent testing laboratory provided by the Owner at his own expense. The Contractor shall

require the manufacturer's cooperation in these inspections. The cost of plant inspection will be the responsibility of the Owner.
 2. Inspection of the liner may also be made by the Engineer or other representative of the Owner after delivery. The liner shall be subject to rejection at any time on account of failure to meet any of the requirements specified, even though sample liner may have been accepted as satisfactory at the place of manufacture. Liner rejected after delivery shall be marked for identification and shall be removed from the job site at once.
- I. Safety

1. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for the working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.
2. The Contractor shall also perform all of the Work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and working with steam or hot water.
3. The Contractor shall provide traffic control meeting MUTCD standards.
4. The safety of pedestrians and the traveling public is the Contractor's responsibility.

J. Materials

1. CIPP Lining

- a. CIPP lining shall be Insituform by Insituform Technologies, Inc., Inliner by Inliner USA, Inc., National Liner by National Envirotech, Inc., or Engineer approved equal.
- b. The liner shall be composed of tubing material consisting of one or more layers of flexible non-woven polyester complying with ASTM F-1216, Section 5.1. The felt tubing shall be impregnated with a thermosetting polyester resin complying with ASTM F-1216, Section 5.2 and catalyst, vinyl ester and catalyst or epoxy resin and hardener. The liner material and resin shall be completely compatible. The outside layer of the tube shall be coated with an impermeable material compatible with the resin and fabric.
- c. Design Criteria - The following design parameter values shall be based upon the following physical condition of the existing pipe to be rehabilitated.
 - Pipe Deterioration: All sections of the pipe shall be considered Fully Deteriorated.
 - Soil Parameters: Soil density, 120 lbs/cu.ft.; soil modules, 700 psi
 - Live Loads: All pipes beneath roadways shall be assumed to carry HS 20 live loads.
 - Ovality: The existing pipe shall be assumed to have an ovality of 2 percent.
 - A factor of safety of 2.0 shall be used.
 - Groundwater: At the surface.
 - Soil Depth: Depth of cover will be determined by field measurements.
 - Short Term Flexural Modulus: 250,000 psi.
 - Design Life: 50 years
- d. The liner shall be capable of fitting into irregularly shaped pipe sections and through bends and dips within the pipeline.
- e. The liner shall be able to cure in the presence of water at a temperature of 180 degrees F or less.

- f. When inverted and cured, the liner shall form a continuous, tight fitting, hard, impermeable liner that is resistant to chemicals found in domestic sewage.
- g. The liner shall be chemically resistant to trace amounts of gasoline and other oil products commonly found in municipal sewerage and soils adjacent to the sewer pipe to be lined.
- h. The liner shall be fabricated to a size that will tightly fit the sewer being rehabilitated after being installed and cured. Allowance for longitudinal and circumferential expansion shall be taken into account when sizing and installing the liner. All dimensions shall be field verified by the Contractor prior to installation of the liner. Field measurements shall be used to ensure maximum closure between the new liner and the existing sewer pipe.
- i. The application of the resin to the felt tubing (wet-out) shall be conducted under factory conditions and the materials shall be fully protected against UV light, excessive heat and contamination at all times.
- j. The length of the liner shall be the length deemed necessary by the Contractor to effectively carry out the insertion of the liner and sealing of the liner at the outlet and inlet structures (i.e. manhole, catch basin, pipe end, or apron). Liner shall be cut flush with pipe end or apron. The required length of liner shall be verified in the field by the Contractor prior to fabrication.
- k. The CIPP liner shall be watertight. All voids between the new cured liner and the existing host pipe shall be filled with non-shrink grout unless otherwise sealed in accordance with requirements found elsewhere in the Contract.
- l. CIPP liner 'End Seals', when required, shall be LMK Insignia End Seal.
- m. The cured liner shall have the following minimum structural properties:

Property (psi)	Test Method	Minimum Standard (psi)
Flexural Strength	ASTM D790	4,500
Flexural Modulus	ASTM D790	250,000
Tensile Strength		3,000

K. Preparation

- 1. Clean each length of pipe to be lined and dispose of any resulting material. The Contractor may be allowed to dispose of waste materials generated by pipe cleaning operations at the City's West Duluth Tool House, located at 40th Avenue West and Superior Street. Disposal only applies to sewer line materials generated from cleaning the pipe. Prior to disposing of material, the City needs to be notified and the clear water needs to be decanted. Unsupervised disposal will not be permitted.
- 2. The Contractor shall conduct a CCTV digital video television inspection of each length of pipe after it is cleaned for the purpose of determining if existing conditions are suitable for the installation of the proposed lining process and to document the location of all service lateral connections and confirm point repair locations. Submit video tapes and logs to Engineer for review and approval prior to proceeding with liner installation. The pre-lining television inspection shall be performed prior to any planned spot repair work AND again immediately prior to liner installation.

3. Contractor shall dye test all service connections prior to lining to determine all active service connections. Contractor shall provide all dye test and/or active service determination documentation to Engineer, with sufficient time for review by the Engineer, prior to installation of liner. The Contractor shall provide all necessary coordination with residents and businesses to gain access to buildings to drop the dye into the wastewater system. The Contractor shall not line over a service connection opening (even if it 'visually' appears inactive) without the approval of the Engineer (or the Engineers' designated representative).
4. All service connections protruding 1-inch or more into the sewer to be lined shall be internally cut or ground down with a robotic cutter to be flush with the host pipe to be lined, prior to liner installation. The robotic cutter shall be monitored by closed circuit television equipment to verify proper cutting and shall be capable of cutting VCP, PVC, DIP, or CIP pipe. Equipment specifically designed for cutting roots from sewers (such as a chain cutter) shall not be allowed. The cost of this work shall be included in the unit cost of the liner installation.
5. The Contractor shall provide bypass pumping of sewage flows where the pipe rehabilitation work is being performed.
6. The Contractor shall notify all property owners who discharge sewage directly into the sewer to be lined that their sewage service will be interrupted and discontinued while the liner is being installed, cured, and active service connections re-opened. The Contractor shall notify each affected property owner once 5 days before and again 24 hours before commencement of the work, giving the date, start time and estimated completion time for the work being performed.
7. Furnish and install the liner in the full length of sewer as shown on the Drawings. The installation of the liner shall be in complete accordance with the applicable provisions herein and the manufacturers' installation requirements. Depending on the Contractor's work experience, a representative of the liner manufacturer may be required to be present during the actual installation of at least 2,000 feet at the start of the work.
8. If, in the opinion of the CIPP liner manufacturer AND the Contractor, the rate of infiltration in the sewer segment is too high that there may be risk washout of the resin, then the contractor shall perform measures, as required, to reduce or eliminate the infiltration prior to pipe lining. If additional spot repairs, chemical grouting, pre-liner, or a groundwater dewatering system is deemed necessary and there are no bid items in the Contract, it will be considered Extra Work. The Contractor shall not proceed with Extra Work without the written approval of the Engineer.
9. If there are calcium deposits or other 'difficult to remove' debris encountered in the existing host pipe that was not visible in the pre-bid CCTV inspection videos, the contractor shall make an extraordinary effort to remove by grinding or other approved methods. If it could not be anticipated reviewing the pre-bid CCTV inspection videos, the extraordinary effort will be considered Extra Work. The Contractor shall not proceed with Extra Work for a removal of debris without the written approval of the Engineer.

L. Installing CIPP

1. Inversion Using Hydrostatic Head

The resin impregnated tube shall be inserted through an existing manhole by means of an inversion ring or standpipe, capable of applying the hydrostatic head required to fully extend the tube to the next designated manhole or termination point. The tube shall be inserted into the inversion standpipe and the tube shall be turned inside out and attached to the standpipe so that a watertight connection is made. The inversion head shall be adjusted to a sufficient height to invert the tube from the starting manhole to the ending manhole and to hold it tight against the existing pipe wall, producing dimples at side connections and flared ends at the manholes. Care shall be taken not to overstress the felt tube at the elevated curing temperatures, which may cause damage or failure prior to cure.

2. General Housekeeping and Site Clean-Up

The Contractor shall take reasonable precautions to control lubricating fluids, inversion and curing process water, steam vents, excess epoxy and liner cutoffs so that the work site and surrounding area are safe and clean to the satisfaction of the Engineer. Where an unavoidable dispersal occurs, the Contractor shall clean up the site immediately.

M. Curing

1. Heating

After the inversion process is completed, the Contractor shall supply a suitable heat source of hot water and steam throughout the section to uniformly raise the liner temperature above the temperature to affect a cure of the resin. The heat source shall be fitted with suitable monitors to gauge temperature of the incoming and outgoing water supply. Another gauge shall be placed between the layers of the impregnated felt tube in the upstream, downstream, and intermediate manholes to determine the temperature during curing. Water temperature in the line during the curing period shall not be less than 140°F or more than 200°F as measured at the heat source return line. Initial cure may be considered complete when the remote sensing device indicates the temperatures and curing time to be adequate, as recommended by the resin/catalyst system manufacturer. The contractor shall maintain a log of the temperature at each sensor during the entire curing process. All condensate water shall be directed into a sanitary sewer. Discharge of condensate water to storm sewers, ground surface, or water bodies will NOT be allowed.

- a. For pipe sizes **less than or equal to 12" in diameter**, the Contractor shall choose either a **hot water cure or steam cure** method as long as the method selected is appropriate (based on manufacturer's installation guidelines) for the existing pipe conditions observed at the time of preparation CCTV inspection.
- b. For pipe sizes **greater than 12" in diameter**, a **hot water cure method shall be used** unless otherwise specified in the Contract, or as approved by the Engineer.
- c. Regardless of the **method of curing** that is actually utilized, **there will NOT be any adjustment to contract unit bid prices** based on the Contractor's assumed method of curing for the Cost Proposal. A copy of the City's pre-bid CCTV inspections videos is available for review. Refer to the project special provisions for contact information.

2. Cooling Down

The Contractor shall cool the hardened cured-in-place-pipe to a temperature below 100°F before relieving the water column. Cool water may be added to the water column while draining hot water from a small hole at the end of the cured-in-place-pipe so that a constant water column height is maintained until cool down is completed. Careful attention should be taken not to cool too quickly to eliminate the possibility of thermos shock. Care should be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed liner.

Disposal of ALL curing process water shall be at the nearest sanitary sewer. No discharge of curing process water will be allowed into storm sewers, streams, rivers, or lakes.

N. Sealing and Cutting of Lining at Manhole

1. Contractor may line multiple sewer segments at one time where possible as determined by the Contractor. Where this is done, the top one-half of the liner in the intermediate manhole shall be neatly removed, and the void behind the liner shall be filled with non-shrink grout. The channel in the manhole shall be a smooth continuation of the pipe (s) and shall be merged with other lines or channels, if any. Channel cross section shall be U-shaped and sides of channels shall be built up with mortar/concrete to provide benches at a maximum of 1 in 12 pitch towards the channel.
2. When cutting around storm sewer and culvert pipe ends, all shavings and dust debris shall be collected and disposed.
3. All cutting and sealing of the liner at manhole connections shall provide watertight pipe and manhole seals with the use of a quick set cement grout or other approved sealant.
4. CIPP line and the existing pipe must be sealed as indicated above before proceeding on to the next manhole section, and all manholes shall be individually inspected for liner cut-offs, benches, and sealing works.
5. CIPP liner End Seals shall be provided at the locations shown on the Plans.

O. Service Connections

1. Reopen all of the existing active service connections in each length of sewer following reformation and cooling of the liner. The exact number and location of service connections shall be determined from the CCTV tapes of the dye testing. It shall be the Contractor's responsibility to accurately field locate all existing active service connections. The service connections shall be reopened from inside the sewer by means of a television camera controlled cutting device appropriate for the liner material and the rehabilitated sewer pipe. All opening shall be clean, smooth, neatly cut, flush with the lateral pipe, and shall receive a brush finish. The bottom of the openings shall be flush with the bottom of the lateral pipe to remove any lip that could catch debris. Openings shall be at least 75 percent of the service lateral pipe if the lateral is to be replaced and at least 95 percent if the lateral is only to be reinstated. If a cleanout is already available, a mini-camera from the cleanout shall be used to assist the operator with trimming. All service cut-out coupons and fragments shall be collected at the nearest downstream manhole.

2. After reopening the service connections, any gaps/voids that are between the liner and the host pipe shall be sealed off with grout, chemical grout, or top hat style of liner as approved by the Engineer. Further, any damage to the service connection lateral or wye caused by the lining Contractor's operation shall be repaired in a similar manner.

P. Quality Control

1. For every 1,000 feet of liner installed, remove specimens of at least 18 inches in length for testing of thickness and flexural properties specified above. The Contractor shall collect the samples using a section of PVC pipe or other device approved by Engineer. The number of tests required may be reduced as approved by the Engineer after sufficient tests are performed to verify the CIPP design, production and installation procedures. Likewise, the frequency of tests may be increased by the Engineer and performed by the Contractor at no additional cost to the Owner when the required tests show that the installed lining does not meet the specifications. The specimens shall be cut from a section of installed and reformed line at an intermediate point or the termination point of the installation. All testing shall be paid for by the Contractor and shall be performed by an independent testing laboratory. Results of the tests for each liner shall be submitted within 30 days after the liner is installed.
2. For every segment of liner installed, the Contractor shall generate a report that documents installation, including date, time, temperature, curing temperature, curing time, etc. The reports shall be submitted to the Engineer prior to requesting payment.
3. Following installation of the liner and re-opening of the service connections and replacement and re-connection of laterals to the liner, Contractor shall conduct a final video-taped color television inspection of the completed work. Copies of these tapes and the videotapes made prior to the liner installation shall be submitted to the Engineer for approval and shall be retained by the Owner. The Contractor shall submit two tapes: one copy of the post installation immediately after the installation of the liner and a second tape that includes tapes of all of the installations for the project after installation of the new service laterals. The contractor shall submit tapes a minimum of 10 days in advance of any payment request to provide the Engineer ample time to review the tapes. There shall be no dry spots, lifts, wrinkles, ridges, splits, cracks, de-laminations or other type defects in the CIPP lining. Defective lining will be removed and pipe re-lined at no additional cost to the Owner. If during the removal process, the pipe is damaged, Contractor will perform a point repair at Contractor's own expense.
4. Groundwater infiltration of the liner shall be zero.
5. All service connections shall be open, clear and watertight.
6. The Contractor is required to maintain the work site in a neat and orderly condition throughout the period of work and after completing the work at each site, remove debris, surplus material and temporary structures erected by the Contractor.
7. All work areas shall be restored to their original condition.
8. Acceptance of CIPP lining shall be based on the Engineer's evaluation of the installation and curing data, results of air testing where required, review of the certified test data of the installed liner, and review of the TV videotapes and manhole inspections.

Q. Measurement

Measurement of cured-in-place pipe liner of the respective diameter will be measured along the horizontal distance of the centerline of the pipeline from center to center of all manholes or to the end of the pipe (or pipe apron) at the top of pipe (12 o'clock position).

Measurement for remote cutting and reconnect services will be made for each service adequately re-opened.

Measurement for CIPP liner end seals will be made for each seal adequately installed.

Measurement for dye testing active service connections will be made for each service located.

R. Basis of Payment

Payment for CIPP lining will be made under bid item **2503.603 (size) CIPP Main Lining** at the contract unit price per linear foot. Compensation shall include all costs of furnishing and installing cured-in-place pipe liner of the respective diameter, including television inspection and taping, cleaning, testing, bypass pumping, connections to existing manholes/structures and all other Work required to complete the items.

Payment for remote cut and reconnect sanitary service will be made under bid item **2503.602 Remote Cut and Reconnect Sanitary Service** at the contract unit price per each. Compensation shall include all costs of furnishing and completing the remote cutting and reconnection of the sanitary service lines into the main sewer line, including a brush finish and the use of the remote television camera and remote cutting tool and all work required to complete the item.

Payment for CIPP liner end seals will be made under bid item **2503.602 (size) CIPP Liner End Seal** at the contract unit price per each. Compensation shall include all costs of furnishing and installing the end seal in between the new CIPP linear and the existing host pipe.

Payment for dye testing active service connections will be made under bid item **2503.602 Dye Testing Active Service Connection** at the contract unit price per each. Compensation shall include all costs of coordination with property owners, furnishing and placing dye, CCTV monitoring to confirm evidence of dye at active services, documentation of observations, and reports submitted to the Engineer.

2503/2504 LOCATING WIRE FOR WATER AND SEWER

Locating wire shall be installed on all HDPE and PVC water and sewer (sanitary or storm) mains and services. Refer to natural gas specifications for locating wire requirements for natural gas installations.

A. Locating Wire for Open Cut installations

Locating (tracer) wire shall be #12 solid copper with "HMWPE" 30 mil insulation. Insulation for sanitary and storm sewer shall be green. Insulation for water main shall be blue. To minimize splices, wire shall be supplied on spools of not less than 500 feet. **Copper clad steel wires are NOT acceptable.**

B. Locating Wire for Directional Drilled Installations.

Two (2) wires shall be pulled for all directional drilled installations. Locating wire shall be **1/8-inch diameter** 7x7 or 7x19 strand braided type 304 alloy stainless steel. The conductors shall be insulated with 45 mil high-density polyethylene (HDPE) jacketing. Insulation for sanitary and storm sewer shall be green. Insulation for water main shall be blue. The wire shall be tested in accordance with ASTM B-1 and D-1248 and spark tested at 7500 VAC. The minimum breaking strength of the wire shall be at least **1700 pounds**; wire that has less than this breaking strength shall not be accepted. To minimize splices, wire shall be supplied on spools of not less than 500 feet. **Copper clad steel wires are NOT acceptable.**

C. Locating Wire for Pipe Bursting.

Two (2) wires shall be pulled for all pipe bursting installations. Locating wire shall be **3/16-inch diameter**, 7x7 or 7x19 strand braided type 304 alloy stainless steel. The conductors shall be insulated with 45 mil high-density polyethylene (HDPE) jacketing. Insulation for sanitary and storm sewer shall be green. Insulation for water main shall be blue. The wire shall be tested in accordance with ASTM B-1 and D-1248 and spark tested at 7500 VAC. The minimum breaking strength of the wire shall be **3700 pounds**; wire that has less than this breaking strength shall not be accepted. To minimize splices, wire shall be supplied on spools of not less than 500 feet. **Copper clad steel wires are NOT acceptable.**

D. Locating Wire Splices

Tracer wire shall remain continuous to the greatest extent possible. Splices in the copper tracer wire should be made with solder, split bolt type connectors or other type approved by the engineer. Splices in the stainless steel tracer wire should be made with split bolt type connectors or other type approved by the engineer. Wire nuts or clip type connectors shall not be used. All connections shall be protected to make them watertight. Waterproofing material shall be 3M 2200 or equal.

E. Locating (Tracer) Boxes

Locating Boxes for **sanitary and storm sewer** applications shall be Snake Pit's magnetized tracer boxes from Copperhead Industries, LLC, (or approved equal) as follows:

Color	Installation Type	Model
Green	Turf	Snake Pit Lite Duty Box Model LD14GTP
Green	Bituminous	Snake Pit Roadway Box Model RB14GTP
Green	Concrete	Snake Pit Concrete/Driveway Box Model CD14GTP

Locating Boxes for **water** applications shall be Snake Pit's magnetized tracer boxes from Copperhead Industries, LLC, (or approved equal) as follows:

Color	Installation Type	Model
Blue	Turf	Snake Pit Lite Duty Box Model LD14BTP
Blue	Bituminous	Snake Pit Roadway Box Model RB14BTP
Blue	Concrete	Snake Pit Concrete/Driveway Box Model CD14BTP

The tracer box shall have a green powder coated cast iron cover for sanitary and storm sewer; or a blue powder coated cast iron cover for water.

All tracer box covers shall have insulated brass connecting lug for direct connection hook-up for a locator transmitter.

All tracer box covers shall have an alpha character stamped on top of the pentagon security bolt. Characters shall be "W" for water; "ST" for storm; "SN" for sanitary.

The Contractor may also use Snake Pit Style boxes with an adjustable top as an acceptable equal for turf installations only. All other substitutions must be approved by the City prior to bidding.

All tracer wire boxes must include a manually interruptible conductive/connective link between the terminal(s) for the tracer wire connection and the terminal for the grounding anode wire connection.

F. Anodes for tracer wire conductivity

Anodes shall be 1 pound (minimum) magnesium anode.

G. Installation Requirements

The locating wire for sewer and water shall be brought to the ground surface at locations shown on the Standard Details, Contract Drawings or the Special Provisions through a locating box. The wire shall be connected to the tracer box terminal.

Locating wire installed on new services on existing mains where no locating wire is currently present shall be connected to a minimum 1-pound magnesium anode installed at the main.

Anodes (1 pound) shall also be installed at all dead ends on tracer wire. Anodes (1 pound) shall be installed on all tracer wire at a maximum interval of 500 feet.

Locating (tracer) boxes shall also be installed on all tracer wire at a maximum interval of 500 feet where valves, services, or other connections are not available.

The locating wire shall be laid directly over the utility. The Contractor shall be responsible for the installation of a locating wire with electrical continuity throughout the entire length.

For open cut installations, the contractor shall install a loop in the tracer wire at the location of each service connection so that the service may be installed later without splicing the tracer wire.

H. Measurement and Payment

All locating wire installed shall be tested for continuity at the completion of the installation. No payment shall be made for pipe with a tracer wire that has not passed the continuity test.

Tracer wire and boxes shall be supplied by the Contractor. There shall be no measurement or payment for tracer wire. The cost of furnishing and placing locating wire shall be considered incidental to the utility.

Payment will be made under Item 2503.602 or 2504.602 (type) Tracer Box at the Contract bid price per each, which shall be compensation in full for all materials, labor and equipment necessary to furnish and install the tracer box where specified in the Standard Details, Contract Drawings or Special Provisions.

2504 WATER MAIN AND SERVICE LINE INSTALLATION

This work shall consist of the construction of water main and building service pipelines utilizing plant fabricated pipe and other appurtenant materials, installed for conveyance of potable water.

All references to Specifications of AASHTO, ASTM, ANSI, AWWA, etc. shall mean the latest published edition or supplement available on the date of advertisement for bids.

A. Materials

1. General Requirements

All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade and other details indicated in the Contract. Unless otherwise indicated, all required material shall be furnished by the Contractor. If any options are provided for, as to type, grade or design of the material, the choice shall be limited as may be stipulated in the Contract Drawings or Specifications.

All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Contract Drawings. Otherwise, the City may require advance approval of material suppliers, product design, or other unspecified details as it deems desirable for maintaining adopted standards.

All pipe furnished for water main and service installations shall be of the type, kind, size and class indicated for each particular line segment as shown on the Contract Drawings and designated in the Contract Items. Wherever connection of dissimilar materials or designs is required, the method of joining and any special fittings employed shall be subject to approval of the Engineer.

2. Ductile Iron Pipe

Ductile Iron Pipe shall conform to the latest requirements of ANSI/AWWA C151/A-21.51. In addition, the pipe shall comply with the following supplementary provisions:

- a. All pipe shall be furnished with cement mortar lining meeting the latest requirements of ANSI/AWWA C104/A-21.4-08 for standard thickness lining. All interior surfaces of the pipe shall have an asphaltic coating at least one mil thick.
- b. The exterior of the pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200 g/m² of pipe surface area. A finishing layer asphaltic topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. The coating system shall conform in every respect to ISO 8179-1 "Ductile iron pipes – External zinc based coating – Part 1: Metallic zinc with finishing layer. Second edition 2004-06-01.

- c. All pipe shall be furnished with push-on type joints conforming to ANSI/AWWA C111/A-21.11 unless specified otherwise in the Special Provisions or shown on the contract drawing.
 - d. When specified in the Special Provisions or shown on the Contract Drawings, joints shall be boltless, flexible, push-on restrained joint such as Flex-Ring by AMERICAN, or TR Flex by US PIPE. Field adaptable restrained joints may be provided through the use of Field Flex-Ring restraints by AMERICAN.
 - e. Where shown on the Contract Drawings, flange joints shall be provided. Flanges shall be standard AWWA C115/A21.15lb threaded on flanges for 250 psi operating pressure. Bolt on flanges such as Uni-flange or Mega-flange may not be substituted for flanged pipe.
 - f. All pipe shall be furnished in 18 or 20-foot nominal lengths.
 - g. Minimum ANSI thickness class furnished shall be Class 52 for all pipe through 16" pipe. For pipes larger than 16" the appropriate class shall be called out in the Special Provisions. Above grade flanged pipe shall be class 53.
 - h. Pipe shall be provided with provisions to maintain electrical continuity for thawing and locating purposes.
 - i. A Certificate of Compliance shall be furnished stating that the materials furnished have been tested and are in compliance with the requirements of this Specification.
3. Ductile Iron Fittings
Fittings shall conform to the latest requirements of ANSI/AWWA C110/A-21.10-08 (Gray Iron and Ductile Iron Fittings), or ANSI/AWWA C153/A-21.53 (Ductile Iron Compact Fittings), all with ductile iron glands and cement lining.
- a. Buried fittings shall be mechanical joint with rubber gaskets.
 - b. Exposed fittings shall be flanged conforming to ANSI B16.1, Class 125 and have full face gaskets.
 - c. Exposed fittings shall be shop primed for painting.
 - d. Fittings shall be provided with provisions to maintain electrical continuity.
 - e. Fittings shall be manufactured in North America or preapproved by the City Chief Engineer of Utilities.
 - f. Mechanical joint bolts shall be as specified elsewhere in this section
 - g. When specified in the Special Provisions or shown on the Contract Drawings, buried fittings shall be boltless, flexible, push-on restrained joint fittings such as Flex-Ring by AMERICAN, or TR Flex by US PIPE. Field adaptable restrained joints may be provided through the use of Field Flex-Ring restraints by AMERICAN.
4. Steel Pipe and Fittings
Steel Pipe shall conform to the requirements of AWWA C202. The grade of steel used in making the pipe and fittings shall be Grade B as covered in AWWA C201 and C202. Joints shall be as specified on the contact drawings or in special provisions. Pipe coating interior and exterior shall conform to AWWA C203. Scotchkote 202 (3M) or approved equal is also acceptable.

Fittings shall meet the same coating requirements and conform to AWWA C207 and C208. Steel weld flanges shall be installed on the pipe for connecting to valves and flanged appurtenances.

All steel shall be made in North America. The Contractor shall provide certification of steel origin to Engineer prior to installation.

5. HDPE Pipe

- a. Water main and service **pipe 4 inches and greater** shall be polyethylene pipe conforming to ASTM 3035 and AWWA C906-15, Polyethylene (PE) Pressure Pipe and Fittings, 4" through 63", for Water Distribution. Pipe furnished shall be approved for potable water and marked to indicate so with a continuous blue stripe. **Pipe shall be PE4710 compound conforming to ASTM D3350 minimum cell classification 445574C-CC3, Pressure Class 200, SDR 11, at 73 deg. F. and have outside diameters similar to ANSI A-21.51 ductile iron pipe.** Joints shall be butt heat fusion type, ASTM F2620. Ends shall be plain for butt fusion joining as specified in the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe.
- b. Water main and service **pipe 3-inches and smaller** shall be polyethylene pipe conforming to the requirements of AWWA C901, current edition, "Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), For Water Service" and ASTM D2239 or D3035. **Pipe shall be PE4710 compound conforming to ASTM D3350 minimum cell classification 445574C-CC3, DR 9, shall have a minimum working pressure of 250 psi at 73 deg. F. and have outside diameters similar to iron pipe size.** Joints shall be butt heat fusion type, ASTM F2620. Joints may be socket fused type for service pipes 3 inches and smaller. Ends shall be plain for butt fusion joining as specified the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe.
- c. Pipe shall be new or stored for a period of time that does not exceed the manufacturer's recommended maximum period of exposure, regardless of the method of storage.
- d. The DR number and pressure rating specified above shall be considered a minimum. Provide stronger class pipe if required by loads imposed by directional drilling pulling operation or pipe bursting.
- e. Shop drawings for HDPE pipe must specify minimum allowable pipe deflection radius.
- f. Reference Standards - American Society for Testing and Materials (ASTM)
 - ASTM D638 – Tensile Method for Tensile Properties of Plastics
 - ASTM D790 – Test Materials for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - ASTM D3035 – Polyethylene (PE) Plastic Pipe (DR-PE) Based on Controlled Outside Diameter
 - ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing
 - ASTM D3350 – Polyethylene Plastic Pipe and Fittings Material

- ASTM F714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- ASTM F2206 – Fabricated Fittings of Butt-Fused Polyethylene Plastic Pipe, Fittings, Sheet Stock, Plate Stock or Block Stock.
- ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

6. HDPE Fittings for pipe 4 inches and greater

- a. Water main fittings and service fittings for **pipe 4 inches and greater** shall be polyethylene pipe conforming to ASTM 3035 and AWWA C906-15, Polyethylene (PE) Pressure Pipe and Fittings, 4" through 63", for Water Distribution. **Fittings shall be PE4710 compound conforming to ASTM D3350 minimum cell classification 445574C-CC3, Pressure Class 200, SDR 11, at 73 deg. F. and have outside diameters similar to ANSI A-21.51 ductile iron pipe.** Fittings shall be butt heat fusion type, ASTM F2620. Ends shall be plain for butt fusion joining as specified in the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe.
- b. All fittings for 4 inch through 12-inch pipe, must be molded if a molded fitting is available including all 45 degree elbows, 90 degree elbows and tees. If a molded fitting is not manufactured, then a fabricated fitting may be used. All 8 x 6 reducers shall be molded or machined. Other size reducers may be fabricated. Molded fittings by Plasson USA, George Fischer Central Plastics or Integrity Fusion Products.
- c. All fabricated fittings shall be rated for a minimum operating pressure of 200 psi. All fabricated fittings shall be equivalent diameter ratio 11 full inside diameter (EDR-11, full ID). Fabricated 90 degree elbows shall have a minimum of 4 sections. Fabricated 45 degree elbows shall be 2 sections. Fabricated reducing tees may be made using branch saddles. Branch diameter shall not exceed two thirds the diameter of the main size, except that 6-inch branch saddles may be installed on 8-inch pipe. Fabricated non-reducing tees and all crosses shall be machined from thicker stock or externally reinforced to provide the 200 psi rating. Any fitting that uses a reduced inside diameter to meet the 200 psi pressure rating will be rejected. Fabricated fittings shall be manufactured by Plasson USA, George Fischer Central Plastics, or ISCO. All other brands of fabricated fittings shall be submitted to the City Chief Engineer of Utilities for pre-approval a minimum of 2 weeks prior to any bids. The City reserves the right to reject a fabricated fitting based solely upon an on-site inspection due to poor workmanship or questionable pressure rating.
- d. HDPE by MJ Adapters shall be molded and shall be manufactured by Central Plastics Company, Plasson USA, Integrity Fusion Products, or equal. The adapter shall comply with AWWA C906 and be manufactured for use on pipe conforming to ASTM D2513, D3035 and F-714. The adapter shall be molded from a PPI and NSF listed pre-blended virgin resin in accordance with the material specifications listed in ASTM D3350 with a cell classification of 445574C and be compatible for heat fusion with any pipe manufactured from a like or similar resin. Adapters shall be tested according to ASTM D1599 and ASTM D1598. HDPE Adapters shall be sized for use with ductile iron pipe size HDPE pipe. Adapters shall be used for all transitions from HDPE to valves, hydrants or ductile iron pipe. All adapters used on pipe larger than 12-inch diameter shall have a 316 stainless steel stiffener. MJ Adapters for use with butterfly

valves shall be designed and shop fabricated not to interfere with valve operation so that the valve can be fully opened. Hand beveling or tapering of MJ adaptors in the field will not be allowed. Mechanical joint bolts shall be as specified elsewhere in this section.

e. Reference Standards - American Society for Testing and Materials (ASTM)

- ASTM D638 – Tensile Method for Tensile Properties of Plastics
- ASTM D790 – Test Materials for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D3035 – Polyethylene (PE) Plastic Pipe (DR-PE) Based on Controlled Outside Diameter
- ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing
- ASTM D3350 – Polyethylene Plastic Pipe and Fittings Material
- ASTM F714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- ASTM F2206 – Fabricated Fittings of Butt-Fused Polyethylene Plastic Pipe, Fittings, Sheet Stock, Plate Stock or Block Stock.
- ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

7. HDPE Fittings for pipe 3 inches and smaller

- a. Water main fittings and service fittings for **pipe 3 inches and smaller** shall be polyethylene pipe conforming to the requirements of AWWA C901, current edition, "Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), For Water Service" and ASTM D2239 or D3035. **Fittings shall be PE4710 compound conforming to ASTM D3350 minimum cell classification 445574C-CC3, DR 9, shall have a minimum working pressure of 250 psi at 73 deg. F. and have outside diameters similar to iron pipe size.** Fittings shall be butt heat fusion type, ASTM F2620. Ends shall be plain for butt fusion joining as specified the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe. All fittings shall be molded polyethylene fused-type suitable for use on iron pipe size (IPS) HDPE pipe.
- b. Reference Standards - American Society for Testing and Materials (ASTM)
 - ASTM D638 – Tensile Method for Tensile Properties of Plastics
 - ASTM D790 – Test Materials for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - ASTM D3035 – Polyethylene (PE) Plastic Pipe (DR-PE) Based on Controlled Outside Diameter
 - ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing
 - ASTM D3350 – Polyethylene Plastic Pipe and Fittings Material
 - ASTM F714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
 - ASTM F2206 – Fabricated Fittings of Butt-Fused Polyethylene Plastic Pipe, Fittings, Sheet Stock, Plate Stock or Block Stock.
 - ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings.

8. HDPE Electrofusion Fittings

All electrofusion fittings shall be manufactured by Plasson USA, George Fischer Central Plastics Company, Integrity Fusion Products, or ISCO; AND shall meet the following requirements:

- a. Electrofusion Transition Service Saddle with Threaded Brass Insert and Tapping Tees with Electrofusion Saddle shall conform to the requirements for HDPE Pipe and Fittings as specified. The electrofusion transition service saddles shall be suitable for the installation of corporation stops as specified.
- b. Couplings used for water mains and services (4 inches and larger) shall be electrofusion type. Couplings used for services (3 inches and smaller) shall be electrofusion or socket fused type.
- c. Electrofusion flex restraints, for use as an attachment component for use where in line concrete thrust restraint is called for on the plan, shall be suitable for the size of pipe intended.
- d. Any other brand of electrofusion fittings shall be submitted to the City Chief Engineer of Utilities for pre-approval a minimum of 2 weeks prior to any bids. Regardless of any pre-bid approvals or subsequent shop drawing approvals, the City reserves the right to reject any electrofusion fitting (including damages due to poor handling, storage, or workmanship) based solely upon appearance noted during an on-site inspection.
- e. Electrofusion fittings must be stored in the manufacturer's sealed shipping bag until incorporation into the work. All electrofusion fittings found in torn, ripped, or cut-open bags will immediately be unacceptable and not used in the work.

9. Transition Couplings

a. Cast Transition Couplings – 4" through 12"

Cast transition couplings shall be furnished with ductile iron sleeves, ductile iron followers and 316 stainless steel bolts. Gaskets shall be natural or synthetic vulcanized rubber recommended for water system use. The finish shall be fusion bonded epoxy meeting ASTM C213. Couplings shall have a size range to connect cast iron to cast iron or cast to ductile iron, or ductile iron to ductile iron as necessary for the application. Estimated pipe outside diameters are shown in the table below. Latter dimension is maximum for pit cast end requirement. Contractor shall verify all pipe dimensions prior to ordering couplings. All couplings shall be rated for 250 psi minimum.

4"	4.80" to 5.10"
6"	6.90" to 7.20"
8"	9.05" to 9.45"
10"	11.10" to 11.50"
12"	13.20" to 13.50"

Couplings shall be Smith Blair 441, JCM 210, Ford FC1, Krausz Hymax, Romac Macro HP, or approved equal.

b. Cast Transition Couplings – 16"

Cast transition couplings (16" size) shall meet the above requirements. Estimated pipe diameters for transition are 17.40" cast or ductile iron pipe to 17.80" cast iron pipe. Contractor shall verify all pipe dimensions prior to ordering couplings. Minimum working pressure shall be 150 psi. Couplings shall be Smith Blair 441 or Ford FC2 or approved equal.

c. Steel Transition Couplings

Steel transition couplings (18" CI through 48" CI) shall be rated for 150 PSI working pressure. Components shall consist of a steel sleeve and follower coated with 12 mils of 3M epoxy #206N. Bolts shall be 316 stainless steel. Gasket shall be Grade 30 rubber. The couplings shall be designed to connect ductile iron pipes to old cast iron pipes, sizes as follows:

Nominal Pipe Size	Ductile Iron O.D.	Cast Iron O.D. (Range)
18"	19.50" to	19.50" – 19.92"
20"	21.60" to	21.60" – 22.06"
24"	25.80" to	25.80" – 26.32"
36"	38.30" to	37.96" – 38.70"
42"	44.50" to	44.20" – 44.50"
48"	50.80" to	50.50" – 50.80"

More than one gasket shall be furnished if necessary to allow connection over the entire cast iron O.D. range. If the gaskets furnished are not interchangeable for all the connection pipe size, then each gasket must be clearly labeled or its container labeled to indicate its applicable pipe O.D. range.

Couplings shall be JCM 203, Rockwell #413 or approved equal.

d. Transition Couplings for HDPE Main and Services

The HDPE to cast iron or ductile iron transition couplings shall be furnished and installed from new HDPE pipe to existing pipe. The transition couplings shall be Smith Blair model 441 or equal. HDPE pipe stiffeners shall also be provided and installed to prevent compression of the HDPE pipe. Pipe stiffeners shall be Smith Blair or equal. Stiffeners shall be designed to prevent over insertion. This transition coupling shall only be used where approved by the Engineer.

Transition couplings **2-inch and smaller** shall consist of HDPE by flared swivel brass or flared swivel stainless steel connections. HDPE shall be plain end for butt fusing. Coupling shall be manufactured by Poly-Cam, Inc., Central Plastics, Inc. or equal.

e. Restrained Couplings

Restrained couplings for used in joining like or unlike pipe materials shall be Romac Alpha Wide Range Restrained Joint couplings or Alphas XL or equal in sizes 4" through 12". No other brands of restrained couplings are currently approved for use. All cast

components (end rings, center ring, grippers and bolt guides) shall be ductile iron, meeting or exceeding the requirements of ASTM A536, grade 65-45-12. Grippers shall be machine sharpened and heat treated. Gaskets shall be nitrile butadiene rubber compounded for water and sewer service in accordance with ASTM D2000, NSF61 certified. Ramp runners shall be reinforced nylon. All bolts and nuts shall be 316 stainless steel with anti-galling protection. Center ring shall be fusion bonded epoxy in accordance with AWWA C213 and NSF 61 certified. Couplings shall be rated for a working pressure of 350 psi. Coupling shall be used where shown on the contract drawings for cast iron, ductile iron, or HDPE pipe.

10. Bell Joint Leak Clamps (3" through 36")

Clamps shall fit AWWA sand cast pipe classes A, B, C, and D and centrifugally cast pipe diameters. Bell and spigot rings shall be ductile iron, Cor-Ten or similar low corrosion type bolts (All bolts and nuts shall be 316 stainless steel with anti-galling protection.), with gaskets suitable for water service. Bell joint leak clamps shall not be installed on new mains.

11. Band Type Repair Clamps

Clamps shall be single band full circle type with a gridded, tapered, overlapping Buna-N Grade 60 gasket designed for repair of water mains. Clamp shall have a stainless steel (Type 316) band and bridge plate, stainless steel (Type 304) lugs, and stainless steel (Type 316) bolts and nuts spaced not more than 2.5 inches c-c. Provisions shall be provided for electrical continuity which will withstand a 10 minute-400 amp current (water filled pipe condition) with no harmful effects. This specification is for band clamps ranging in size from 2" through 12" and widths approximately 7-1/2" to 15". Clamp shall be Smith Blair 256, PowerSeal Model 3121CS or Ford F1SH. All other models must be approved prior to bidding by the Chief Engineer for Utilities. Clamp 16" and larger shall be PowerSeal 3122SST. Band Type Repair Clamps must fit the following O.D. range:

Pipe Size	Steel OD (In.)	Ductile or Cast Iron OD (In.)
2"	2.35 – 2.63	-
3"	3.36 – 3.60	3.73 – 4.00
4"	4.45 – 4.73	4.80 – 5.10
6"	6.56 – 6.96	6.90 – 7.20
8"	8.54 – 8.94	8.99 – 9.39
10"	10.64 – 11.04	11.10 – 11.40
12"	12.60 – 13.00	13.20 – 13.50
16"	-	17.13 – 17.90

12. Tapping Sleeves

a. Tapping Cast Iron, Ductile Iron or Steel Mains

(4" though 10" tap on 6" through 30" cast iron, ductile iron or steel mains) Sleeves shall conform to AWWA C223 and consist of two sections of heavy welded **stainless steel** (Type 316) which bolt together on a main pipe and seal against a full encirclement gasket. Flange shall be AWWA C228 Class SD, ANSI 175 pound (sizes up to 12") or ANSI 150 pound (sizes greater than 12") suitable for mating to a flange by mechanical joint gate valve. Outlet body shall have a 3/4 inch NST test plug. Fitting shall be Type 316 stainless steel. Bolts and nuts shall be Type 316 stainless steel. Fitting shall be similar or equal to **PowerSeal 3490** tapping sleeve or **JCM 452** tapping sleeve and in the sizes and O.D. ranges specified.

b. Tapping HDPE Mains

Sleeves shall conform to AWWA C223 and consist of two sections of heavy welded **stainless steel** (Type 316) which bolt together on a main pipe and seal against a full encirclement gasket. Flange shall be AWWA C228 Class SD, ANSI 175 pound (sizes up to 12") or ANSI 150 pound (sizes greater than 12") suitable for mating to a flange by mechanical joint gate valve. Outlet body shall have a 3/4 inch NST test plug. Fitting shall be 316 stainless steel. Bolts and nuts shall be Type 316 stainless steel. Fitting shall be similar or equal to **JCM model 452** tapping sleeve (currently no other product is considered equal for use with HPDE main pipe without field testing by City of Duluth).

The size of the tap pipe shall be restricted to a maximum of two-thirds of the size of the HDPE main pipe, except that a 6" tap on 8" HDPE main will be acceptable.

Stainless steel tapping sleeves for HDPE pipe shall ONLY be used where approved by the Chief Engineer for Utilities.

13. Fire Hydrants

Fire Hydrants shall be Waterous Pacer Traffic Model WB67-250 or Mueller Super Centurion 250 conforming to the requirements of AWWA C502 and the following supplemental requirements:

- a. Main Valve Opening – 5 1/4 inches nominal diameter.
- b. Bury Depth – 8 1/2 feet measured from the bottom of the branch pipe connection to the finished ground line at the hydrant.
- c. Upper Standpipe Length – 22 inches or 16 inches.
- d. Nozzles – One pumper nozzle, City of Duluth Standard thread per Standard Detail drawing W-16; and two hose nozzles, 2 1/2 inch (ID), with National Standard Fire Hose Coupling Screw Threads. One of the hose nozzles shall have a manufacturer's provided 'vented cap'.
- e. Hydrant operating mechanisms shall be provided with Buna-N "O" ring seals preventing entrance of moisture.
- f. The exterior of the hydrant base shall be supplied with a fusion bonded epoxy coating.

- g. Connection shall be a 6 inch mechanical joint with an anchoring tee, tapping tee or tee complete with gland, Cor-Ten or similar low corrosion type bolts, and harnessing lugs. 6 ounce zinc anode caps conforming to ASTM B-418 shall be installed on the bolts on all mechanical joint fittings. Alpha restraint connection may be provided or fusible HDPE stubs of the same pipe diameter and SDR as the hydrant lead pipe.
- h. Operating and nozzle cap nuts shall be a pentagon, 1-1/2 inches point to face. Operating nut shall be two-piece variation. Operating nut shall have an O-ring or seal ring to keep water and dirt from entering the bonnet. Opening shall be counterclockwise.
- i. Design of hydrant shall allow for removal of the main and waste valve seats without excavating or disturbing the ground.
- j. Portions of City owned hydrants above the ground line shall be primed and painted chrome yellow. Privately owned hydrants shall be primed and painted blue. Coating below the ground line shall be according to standards.
- k. A traffic flange and operating rod coupling shall be located not more than 2 inches above the ground line and be designed so that in the event of an accident or breaking of the hydrant above the ground line, the main valve will remain closed.
- l. Lower flange on the nozzle section shall be the swivel type.
- m. Hydrants shall be provided with an outlet for drainage in the base or barrel, or between the base and barrel, unless the Special Provisions require that drain outlets be omitted or plugged.
- n. All hydrant bolts and nuts below grade shall be 316 stainless steel.
- o. Mechanical joint bolts shall be as specified elsewhere in this section.
- p. Hydrant Markers shall meet the following general requirements: 1) rods shall be 60" tall UV resistant fiberglass; 2) springs shall be zinc plated or type 304 stainless steel; 3) base plates shall be zinc plated steel, type 304 stainless steel, or powder coated steel 'top-mount' bracket; and 4) bands shall be 6" red and white highly reflective UV resistant tape/sheeting.

14. Valves - General

Valve sizes twelve inches (12") and smaller shall be **gate** type. Valves sixteen inches (16") and larger shall be **butterfly** type exclusively. All valves shall be made in the North America.

15. Gate Valves (12" and smaller only)

Gate valves shall be manufactured and furnished in accordance with an approved pattern and shall conform to the requirements of AWWA C509 or C515 for resilient seated gate valves, and all gate valves must meet such supplementary requirements as may be stipulated in the Contract Drawings or Special Provisions and the provisions hereof.

Unless otherwise specified, the valves furnished shall comply with the following supplementary requirements.

- a. All gate valves shall have a working pressure rating of 250 psi.

- b. Gate valves shall be solid disc with resilient seating.
- c. The wedge shall be ductile iron and fully encapsulated with EPDM rubber.
- d. All valves shall be furnished with triple O-Ring stem seals. The O-Rings above the thrust collar shall be fully replaceable with the valve “open” and under full pressure. A third O-ring shall be provided below the thrust collar.
- e. Valves shall have a two-inch square operating nut opening counter-clockwise.
- f. All valves shall be of the non-rising stem type.
- g. Each valve shall have mechanical joint ends or fusible HDPE stubs of the same pipe diameter and SDR as the main. MJ joints shall be complete with gasket, gland, and bolts. Bolts or valve flange shall be provided with means for preventing the bolt from slipping in the slotted holes. Alpha restraints may be provided for end connections.
- h. The exterior of the valve shall be supplied with a fusion bonded epoxy coating.
- i. All exposed bolts on the valve, including stuff box and bonnet bolts shall be 316 stainless steel.
- j. Mechanical joint bolts shall be as specified elsewhere in this section.
- k. Valves shall be manufactured by American Flow Control, Clow, Dezurik, Mueller, or equal. All “or equal” valves shall be preapproved by the City Chief Engineer for Utilities prior to bidding. All valves shall be made in North America. Shop drawings for gate valves shall include a statement attesting to their country of origin.
- l. Gate valve box adapters shall be ¼ inch steel adapter and ¾ inch neoprene gasket. The steel adapter shall be coated with polyurethane protective coating. Adapters shall be manufactured by Adaptor, Inc., or PowerSeal.

16. Butterfly Valves (16” and larger sizes only)

Butterfly valves shall conform to the requirements of AWWA C504, Class 150B and all butterfly valves must meet such supplementary requirements as may be stipulated in the Contract Drawings or Special Provisions and the provisions hereof.

Unless otherwise specified, valves furnished shall comply with the following supplementary requirements:

- a. Unless otherwise noted in the Plan, all butterfly valves shall have a working pressure rating of 150 psi.
- b. Manual actuator equipped with standard 2-inch square operating nut, split V type or O-ring stem seal and enclosed in a lubricating gear box. For buried installations, valves shall be equipped with a side-mounted actuator designed to accept a valve box. Valves shall be permanently lubricated with no packing adjustment.
- c. Valve disc shall be cast iron conforming to ASTM 126, Class B or ASTM A48, Class 40, alloy cast iron conforming to ASTM A436 or A439, or ductile iron conforming to ASTM A536.
- d. Valves shall open counter-clockwise.
- e. The exterior of the valve shall be supplied with a fusion bonded epoxy coating.

- f. Valves shall be furnished with mechanical joint ends.
- g. All exposed bolts, screws, washers or nuts on the valve shall be 316 stainless steel.
- h. Mechanical joint bolts shall be as specified elsewhere in this section.
- i. Valves shall be manufactured by American Flow Control, Valmatic, Clow, Dezurik, Henry Pratt, Mueller, Waterous, or equal. All "or equal" valves shall be preapproved by the City Chief Engineer for Utilities prior to bidding. All valves shall be made in North America. Shop drawings for butterfly valves shall include a statement attesting to their country of origin.
- j. Butterfly valve box adapters shall be ¼ inch steel adapter and ¾ inch neoprene gasket. The steel adapter shall be coated with polyurethane protective coating. Adapters shall be manufactured by Adaptor, Inc.

17. Valve Boxes

Valve Boxes shall be 5 1/4" cast iron shaft, 'three-piece' screw-type, consisting of the following parts:

Cover	Stay-put type, " WATER " cast thereon, with solid edges (no grooves or flutes on edge)
Top Section	26" or 26.5" length
Extension Section	30" length (effective 24" length)
Bottom Section	36" length
Base	#6 Round Base

All parts must be interchangeable with Bingham and Taylor #4906 and Tyler #6860. Valve box assemblies shall be manufactured in Northern America or preapproved by the Engineer.

Water valve pavement adjustment rings shall be ESS Brothers pavement adjustment ring or equal. Rings shall be cast iron.

18. Copper Pipe and Fittings

- a. Copper pipe less than 3 inches in nominal diameter shall conform to the requirements of ASTM B88 for Seamless Copper Water Tube, Type K, Soft Annealed temper.
- b. Fittings for Copper Tubing shall be "No-Lead Brass", having uniformity in wall thickness and strength, and shall be free of defects affecting serviceability. No-Lead Brass shall not contain more than nine one hundredths of one percent (0.09% or less) total lead content by weight. All brass fittings shall meet ANSI/NSF Standard 61. All threads for underground service line fittings shall conform to the requirements of AWWA C800. Unless specified, the fittings furnished shall comply with the following requirements:
 - 1) Quarter (90°) bend corporation stop couplings and eighth (45°) bend corporation stop couplings shall be Mueller H-15068 and H-15063 respectively, or an approved equal. Couplings shall be provided with an inside copper service flare thread on one end and a copper tube flare nut on the other end.

- 2) Three-part union couplings for connecting copper tubing to copper tubing shall be Mueller H-15400 or an approved equal. Couplings shall be provided with copper tube flare nuts on both ends.
- 3) Pack joint straight couplings for connecting copper tubing to copper tubing if specified, shall be Ford C44-XX (as appropriate for the required size) or an approved equal. Both ends of couplings shall be pack joints, with split clamp joint nuts with 316 stainless steel set screws.

19. Corporation Stops

Corporation Stops shall be Mueller 300 series, Ford F600 series or an approved equal. Inlet connection shall be a male tap end and shall have Mueller (cc) tapered threads conforming to AWWA Standard. Outlet connection shall be a copper service thread straight coupling connection suitable for use with ASTM B88 Type K copper service tubing and shall be provided with a copper tube flare nut.

20. Curb Stops

Curb Stops shall be quarter turn check, Minneapolis Pattern thread top, with AWWA standard flared copper pipe connections on both ends. Curb stops shall be Mueller B-25154N, Ford B22 series, or approved equal.

21. Curb Boxes

Curb Box shall be magnetized tracer box style as specified in 2503/2504 LOCATING WIRE FOR WATER AND SEWER, furnished and installed by the Contractor. Iron pipe for curb box shall be supplied by the City and installed by the Contractor as shown on the Standard Details.

22. Polyethylene Encasement Material

Polyethylene encasement shall be V-Bio. V-Bio encasement shall consist of three layers of co-extruded linear low density polyethylene (LLDPE), fused into a single thickness of not less than 8 mils. The inside surface shall be infused with a blend of antimicrobial biocide and a volatile corrosion inhibitor. Ductile iron water main shall be encased in polyethylene where shown on the Contract Drawings or required in the Special Provisions..

23. Mechanical Joint Bolts

All mechanical joint bolts and nuts used on all buried fittings, valves and hydrants shall be high strength, low-alloy, corrosion resistant, Cor-Ten or similar low corrosion steel bolts. Bolts shall meet or exceed ASTM A242 or ASTM A588 and ANSI/AWWA C111/A21.11-17. Nuts shall meet or exceed ASTM A563 Grade C3 and ANSI/AWWA C111/A21.11-17. Bolts and nuts shall also have a base zinc plating and a "blue" colored fluoropolymer dry film coating and lubricant commonly referred to as polytetrafluoroethylene (PTFE) and under the product name of Xylan 1424, Cor-Blue, FluoroKote#1 or approved equal. Anode caps shall also be installed as specified below.

24. Zinc Anode for Corrosion Protection

A 12-pound (minimum) zinc anode, packaged in backfill bag and copper lead wire, shall be attached to an MJ bolt for all fittings, valves, and hydrants as shown in the standard detail W-18.

A 5-pound (minimum) zinc anode, packaged in backfill bag and copper lead wire, shall be attached to a brass clamp provided on all copper water service pipes as shown in the standard detail W-5.

Anode shall be composed of LME Grade Zinc, Super High Grade Zinc, or High Grade Zinc conforming to ASTM B-418 Type II alloy standard. The anode shall be packaged in a low resistance backfill mixture (gypsum) bag and supplied with 10 feet of #12 solid copper lead wire that is connected to galvanized steel core by manufacturer.

25. Magnesium Anode for Locating (Tracer) Wire Continuity

A 1 pound (minimum) magnesium anode shall be provided at all dead ends on tracer wire, and/or at 500 feet maximum intervals. Refer to section 2503/2504 Locating Wire for Water and Sewer elsewhere in this standard.

26. Anode Bolt Caps

Zinc anode bolt caps shall be 6 ounce conforming to ASTM B-418. All MJ bolts shall have anode caps installed.

B. Construction Requirements

1. General Provisions

Water main shall be installed to provide a minimum 7.6 feet of cover over the top of the pipe (except that a minimum 8.0 feet of cover shall be provided for 'dead end' water main) AND provide minimum separation distance from other pipes and structures in accordance with the current edition of the '*Recommended Standards for Water Works*' published by Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (also commonly referred to as '10 states standards').

In no case shall the water main be installed with less than 6 inches of clearance to another structure. Where the water main may be exposed to freezing due to insufficient cover or exposure from other underground structures, the water main shall be insulated as directed by the Engineer.

Requirements for site clearing, excavation, preparing trench, backfilling and restoration are contained in 2451 EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES of these specifications and the State of Minnesota Department of Transportation "Standard Specifications for Construction" current edition, and shall govern the execution of work where the specifications therein are not in conflict with more specific requirements contained in this section, the Standard Details, Contract Drawings or the Special Provisions.

All horizontal directional drilling shall be performed in accordance with (2503/2504/2505) HORIZONTAL DIRECTIONAL DRILLING of these specifications.

2. Handling and Inspection

Proper and adequate implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. Unloading, distribution and storage of pipe and appurtenant materials on the job site shall be as approved by the Engineer. All materials shall be handled carefully, as will prevent damage to protective coatings, linings, and joint fittings; preclude contamination of interior areas; and avoid jolting contact, dropping, or dumping.

Before being lowered into laying position, the Contractor shall make a thorough visual inspection of each pipe section and appurtenant units to detect damage or unsound conditions that may need corrective action or be cause for rejection. Inspection procedure shall be as approved by the Engineer, with special methods being required as he deems necessary to investigate suspected defects more definitely. The Contractor shall inform the Engineer of any defects discovered and the Engineer will prescribe the required corrective actions or order rejection. Any HDPE pipe with scratches, cuts or scrapes deeper than 10% of the wall thickness shall not be used unless the damaged section is cut out.

Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.

Store pipe on level surface. Pipe may be placed in pyramidal stacks provided the number of courses recommended by manufacturer is followed and pipe is chocked on each side to prevent roll out of the layers. Cover pipe ends to prevent dirt, debris, wildlife and weather from entering. HDPE pipe stored for more than 3 weeks should be covered for protection from sunlight and weather.

Do not dump pipe from conveyance. Unload pipe 12 inch (300 mm) and smaller by hand with ropes and skids. Unload pipe larger than 12 inch (300 mm) or pipe bundles with mobile unloading equipment. Use wide slings for hoisting large pipe with boom trucks, cranes or lifts. Reinforced web slings are acceptable; chains, wire ropes or fiber ropes are not acceptable slings. Use of hooks for unloading is also unacceptable.

3. Pipe Laying Operations

Trench excavation and bedding preparations shall proceed ahead of pipe placement as will permit proper placement and joining of the pipe and fittings at the prescribed grade and alignment without unnecessary hindrance. Every reasonable precaution shall be taken to prevent foreign materials from entering the pipe and fittings while they are being placed in the line. The water main materials shall be carefully lowered into laying position by the use of suitable restraining devices. Under no circumstances shall the pipe be dropped or dumped into the trench.

At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connection, but they shall be no larger than would be adequate. No pipe material shall be laid in water nor when the trench or bedding conditions are otherwise unsuitable or improper. Unless otherwise permitted by the Engineer, bell and spigot pipe shall be laid with the bell ends facing in the direction of laying.

When placement or handling precautions prove inadequate, in the Engineer's opinion, the Contractor shall provide and install suitable plugs or caps effectively closing the open ends of each pipe section before it is lowered into laying position, and they shall remain so covered until removal is necessary for connection of an adjoining unit.

As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted around the pipe. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is affected.

At all times when pipe laying is not in progress, including noon hour and overnight periods, all open ends of the pipe line shall be closed by watertight plugs or other means approved by the Engineer. If water is present in the trench, the seals shall remain in place until the trench is pumped completely dry.

4. Aligning and Fitting of Pipe

The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth square-cut end. Cast iron or ductile iron pipe shall be cut with approved mechanical cutters. The electric-arc cutting method, using carbon or steel rod, will be approved for use on the larger size pipe where mechanical cutters are not available. Flame cutting will not be allowed under any conditions. All rough edges shall be removed from the cut ends of pipe and, where rubber gasket joints are used, the outer edge shall be rounded or beveled by grinding or filing to produce a smooth fit.

When necessary to deflect the pipe from a straight line either in the vertical or horizontal plane, to avoid obstructions, or produce a long radius curve, the amount of deflection allowed at each joint shall not exceed the allowable limits established in the following tables:

MAXIMUM PERMISSIBLE DEFLECTION IN LAYING PUSH-ON JOINT FOR DUCTILE IRON PIPE					
Pipe Size	Max. Angle	MAX OFFSET PER PIPE		Approx. Minimum Radius	
		18' length	20' length	18' length	20' length
3" to 12"	5°	19"	21"	205'	230'
16" to 24"	3°	11"	12"	340'	380'
30" to 36"	2°	7.5"	8"	510'	570'

MAXIMUM PERMISSIBLE DEFLECTION IN LAYING MECHANICAL JOINT FOR DUCTILE IRON PIPE			
Pipe Size	Max. Angle	MAX. OFFSET PER PIPE	
		18' length	20' length
4"	8.3°	31"	35"
6"	7.1°	27"	30"
8" to 12"	5.3°	20"	22"
16"	3.5°	13"	15"
18" & 20"	3.0°	11"	12"
24" & 30"	2.3°	9"	10"
36"	2.0°	8"	9"

Connection and assembly of joints shall be accomplished during the setting, aligning and fitting operations, in accordance with the provisions of this specification to the extent that the jointing requirements will permit.

HDPE pipe may be deflected at a maximum radius of 25 times the nominal pipe OD. When a fitting or connection is present, the maximum radius shall be 100 times the nominal pipe OD.

5. Blocking and Anchoring of Ductile Iron Pipe

All plugs, caps, tees, bends and other thrust points shall be provided with reaction backing, or movement shall be prevented by attachment of suitable restraining devices, in accordance with the requirements listed below and the Standard Detail Drawing.

- a. All horizontal bends, plugs, caps and branch tees shall be provided with concrete buttresses.
- b. For 16" and smaller diameter, precast concrete blocks may be used in lieu of cast in place concrete when used in conjunction with "Mega-lug" joint restraints. Precast blocks shall be stepped out as installed to provide similar surface area as the cast in place thrust blocks. Use of "Mega-lug" restraints only without blocking is only acceptable if adjacent pipe is restrained as described below.
- c. All vertical bends, except welded steel joints, exceeding 11-1/4 degrees deflection shall be provided with concrete buttress blocking at the low points with metal tie rod or strapping restraints at the high points.
- d. Offset bends made with standard offset fittings need not be strapped or buttressed, unless installed in combination with another fitting.

All necessary fittings, bands, tie rods, nuts, and washers, and all labor and excavation required for installation of reaction restraints shall be furnished by the Contractor and included in the contract unit price for the pipe installation.

Concrete blocking shall be at least 2 inches nominal thickness.

Concrete buttresses shall be poured against firm, undisturbed ground and shall be formed in such a way that the joints will be kept free of concrete and remain accessible for repairs. The concrete mix used in buttress construction shall meet the requirements for Concrete Mix No. 3G52 of MN/DOT 2461. Buttress dimensions shall be as indicated on the Standard Details.

All metal parts of tie rod or strap type restraints shall be galvanized.

“Megalug” joint restraints by Ebba Iron, Inc., or Uni-Flange Series 1400 “Block Buster” by Ford, may be substituted for rodding and blocking. Retainer (set screw type) glands may not be used in lieu of approved restraints or buttresses. “Megalug” and “Blockbuster” restraints may only be used on ductile iron pipe and shall not be used on any existing cast iron pipe.

When using “Megalug” type restraints in lieu of blocking, the pipe shall be restrained in each direction from the fitting a sufficient distance to prevent joint separation upstream or downstream. The minimum length of restrained pipe required shall be as shown on the contract drawings or as specified in Special Provisions. If no minimum length for restrained joints is specified, the Contractor shall submit the restrained joint calculations to the Engineer for review prior to construction or restrain a minimum of 42 feet in each direction for pipes 12 inches and smaller in diameter.

6. Blocking of HDPE Pipe

All plugs, caps, tees, bends, and other thrust points shall be provided with concrete blocking if there is an unstrained joint within 42 feet of the thrust point. Blocking is not required when all joints within 42 feet are restrained or fused. When required, concrete blocking shall be installed per the Standard Details.

7. Locating Wire

Locating (tracer) wire shall be installed on all plastic water mains and services.

8. Polyethylene Encasement of Pipeline

Ductile iron pipe, valves, fittings, and appurtenances, shall be fully encased in V-Bio encasement where shown on the Contract Drawings or required in the Special Provisions.. The film shall be furnished in tube form for installation on pipe and all pipe-shaped appurtenances such as bends, reducers, off-sets, etc. Sheet film shall be provided and used for encasing all odd-shaped appurtenances such as valves, tees, crosses, etc.

The polyethylene tubing shall be installed on the pipe prior to being lowered into the trench. Tubing lengths shall be sufficient to provide a minimum overlap at all joints of one foot or more. Overlap may be accomplished with a separate sleeve tube placed over one end of the pipe prior to connecting another section of pipe, or by bunching extra overlap material at the pipe ends in accordion fashion. After completing the pipe jointing and positioning the overlap material, the overlap shall be secured in place with plastic adhesive tape wrapped circumferentially around the pipe not less than three turns.

After encasement, the circumferential slack in the tubing film shall be folded over at the top of the pipe to provide a snug fit along the barrel of the pipe. The fold shall be held in place with plastic adhesive tape applied at intervals approximately three feet along the pipe length. Also, any rips, punctures, or other damage to the tubing shall be repaired as they are detected. These repairs shall be made with adhesive tape and overlapping patches cut from sheet or tubing materials.

At odd-shaped appurtenances such as valves, the tubing shall overlap the joint and be secured with tape, after which the appurtenant piece shall be wrapped with a flat film sheet or split length of tubing by passing the sheet under the appurtenance and bringing it up around the body. Seams shall be made by bringing the edges together, folding over twice and taping down. Wherever encasement is terminated, it shall extend for at least two feet beyond the joint area.

Openings in the tubing for branches, service taps, air valves and similar appurtenances shall be made by cutting an X-shaped slit and temporarily folding back the film. After installing the appurtenance, the cut tabs shall be secured with tape and the encasement shall be completed as necessary for an odd-shaped appurtenance.

9. Electrical Continuity in Ductile Iron Pipe

Provisions shall be made to ensure electrical continuity between all joints, fittings, and valves. Two serrated brass wedges shall be inserted for 2 inch to 12 inch push-on joints on ductile iron pipe or cable bond may be used. Four wedges per joint shall be used for larger pipe. Continuity for mechanical joints may be provided using copper clips inserted in the gasket by the manufacturer, armored tipped gaskets, copper strap, or cable bond. Megalug joint restraints shall not be used for electrical continuity.

10. Connection and Assembly of Joints

a. General

Where rubber gasketed joints are specified, care shall be taken during the laying and setting of piping materials to insure that the units being joined have the same nominal dimension of the spigot outside diameter and the socket inside diameter. A special adaptor shall be provided to make the connection when variations in nominal dimension might cause unsatisfactory joint sealing.

Immediately before making the connection, the inside of the bell or socket and the outer surface of the spigot ends shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. Insertion of spigot ends into the socket or bell ends shall be accomplished in a manner that will assure proper centering and insertion to full depth. The joint seal and securing requirements shall be as prescribed below for the applicable pipe and joint type.

No open ends of water main pipe will be allowed for more than one hour on any pipe section. Caps shall be mechanically attached to the end of the pipe. Taping and bagging the end of the pipe will not be allowed. The Contractor shall weight the pipe as necessary to prevent floatation.

b. Push-On Joints

The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the ball socket. A thin film of approved gasket lubricant shall be applied to either the inside surface of the gasket or the outside surface of the spigot end, or to both. Care shall be taken while inserting the spigot end to prevent introduction of contaminants. The joint shall be completed by forcing the spigot end to the bottom of the socket by the use of suitable pry-bar or jack type equipment. Spigot ends which do not have depth marks shall be marked before assembly to insure full insertion. Field cut pipe shall be filed or ground at the spigot edge to resemble the manufacturer's fabricated detailing.

c. Mechanical Joints

The last eight inches of the outside spigot surface and the inside bell surface of each pipe and appurtenance joint shall be painted with a soap solution after being thoroughly cleaned. The gland shall then be slipped on the spigot end with the lip extension toward the socket or bell end. The rubber gasket shall be painted with soap solution and be placed on the spigot end with the thick edge toward the gland. An approved lubricant provided by the pipe manufacturer may be used in lieu of the soap solution.

After the spigot end is inserted into the socket to full depth and centered, the gasket shall be pressed into place evenly around the entire joint. After the gland is positioned behind the gasket, all bolts shall be installed and the nuts tightened alternately to the specified torque, such as to produce equal pressure on all parts of the gland.

Unless otherwise specified, the bolts shall be tightened by means of a suitable torque-limiting wrench to within a foot-pound range of: 45 to 60 for 5/8" bolts; 75 to 90 for 3/4" bolts; 100 to 120 for 1" bolts, and 120 to 150 for 1-1/4" bolts.

d. Welded Joints for Steel Pipe

All steel pipeline welding shall be done by Certified Pipeline Welders in accordance with AWWA C206. Contractor shall furnish the Department with evidence of certification at or prior to the contract award date unless a current certification is presently on file with the Department. Pipe and fittings shall be joined with a butt weld. Valves and other control devices shall be connected to the pipe with a steel flange welded to the pipe. Any exposed metal surface, weld or damaged coating shall be prepared and coated with an approved rust preventative prior to backfilling.

e. Qualifications for Joining HDPE Water Main Pipe

Before being permitted to make joints on the HDPE water main pipe, all joiners shall be qualified and successfully complete a qualification test as required in accordance with the Qualifications for Joining PE Pipe, of the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe.

f. Fusion Joining of HDPE Water Main and Service Pipe

All HDPE water main pipe and fittings shall be joined by butt fusion or electrofusion procedures as specified in the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe. Water branch or tap service pipe of any diameter shall be joined by butt fusion except where approved by the Engineer.

Socket couplings may also be used on tap service pipe where approved the Engineer. Unless otherwise directed by the pipe manufacturer's recommendations, the heating tool surface temperature must be minimum 400°F to 450°F maximum.

The use of electrofusion couplings shall be minimized. Electrofusion couplings may not be installed directly on HDPE fittings. All fittings must have a minimum of 2'-0" stub of HDPE pipe butt fused directly to the fitting prior to installation of an electrofusion coupling. Use of an alignment clamp is required for installation of ALL electrofusion couplings. On 12" and larger HDPE pipes, rounding clamps must be used for installation of ALL electrofusion couplings AND prior to electrofusion, ALL couplings shall be checked with a feeler gauge to ensure the gap between the coupler and the pipe is within the manufacturers tolerance.

HDPE pipe shall be prepared prior to fusing by use of an approved peeler. Paint scrapers, wood rasp or together similar device shall NOT be used. The peeler shall remove a strip of material between 0.007" and 0.014" thick. The total cumulative thickness of material removed shall not exceed 0.04" when multiple passes are made with the peeler.

When peeling, the Contractor shall lightly precut the pipe longitudinally so that peels fall off and do not rub on the freshly peeled surface.

All pipe cleaning, peeling and fusion shall be completed in one continuous process. Where fittings are not immediately fused, the pipe must be peeled again in a new location. During fusing operations, the pipe must be protected from dirt and dust accumulation. If the peeled areas is allowed to be covered with dust or dirt, the pipe must be peeled again in a new location.

All electrofusion joining shall be completed in accordance with the "**MAB Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene (PE) Pipe**" available from the Plastic Pipe Institute web site:

<http://plasticpipe.org/pdf/mab-generic-ef-110515.pdf>

11. Connect to Existing Water Main

This work consists of connecting the new water main to the existing water main, including locating the existing water main and furnishing and installing the proper fittings and adapters or transition couplings needed to make a complete connection. Where specified, use restrained couplings.

12. Water Service Installation

a. General Provisions

Water service lines, complete with all required appurtenances, shall be installed as required by the Contract, in accordance with all pertinent requirements for main line installations together with the provisions hereof.

Installation of service lines shall be in accordance with the Standard Detail Drawing(s), the applicable requirements of these construction standards, and the project Special Provisions.

It shall be the responsibility of the Contractor to keep work exposed so the Engineer may obtain an accurate record of the location, depth and size of each service connection and other pertinent data such as the location of curb stops and pipe ends.

Water service lines shall normally be installed by trenching and be subject to the same requirements as prescribed for the main pipeline installation. Where water service lines are installed alongside of sanitary, or storm sewer service lines, installation shall be such as to maintain the minimum specified clearances between pipelines and provide proper and adequate bearing for all pipes and appurtenances. Subject to minimum clearances, the water service may be laid in a common trench excavated principally for sewer installation, either by widening the trench as necessary or by providing a shelf in the trench wall where ground stability will permit.

Water service lines may be laid directly on any solid foundation soil that is relatively free of stones and hard lumps. However, when specified or ordered, aggregate materials shall be furnished and placed as necessary to secure proper foundation drainage, pipe covering, or backfill support.

Water service lines shall be installed to provide a minimum 7 feet of cover over the top of the pipe AND provide minimum separation distance from other pipes and structures in accordance with the current edition of the '*Recommended Standards for Water Works*' published by Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (also commonly referred to as '10 states standards'). In no case shall the water service line be installed with less than 6 inches of clearance to another structure. Where the service pipe may be exposed to freezing due to insufficient cover or exposure from other underground structures, the water pipe shall be insulated as directed by the Engineer.

Water service lines shall be installed on a straight line at **right angles to the water main** or property lines as directed by the Engineer. Unless otherwise specified, the service line shall be terminated at the curb stop, where it shall be connected to an existing line or, in the case of undeveloped property, capped or plugged at the right of way line, as approved by the Engineer.

Reconnecting existing water service shall be required when installing a new water service and connecting it to an existing water main. The contractor shall confirm the

size of each existing water service and provide necessary fittings to adapt from the new service pipe to the existing service pipe.

b. Service Pipe

Minimum pipe size for service installations shall be ¾-inch nominal diameter for copper pipe, or 1-inch nominal diameter for HDPE pipe. Larger size pipe will be specified for commercial and industrial tap service and for some domestic service as specifically identified.

Seamless copper service piping of ¾-inch to and including 1-1/4 inches in diameter shall be installed in one piece without intermediate joint couplings between the corporation stop at the water main tap and the curb stop. Larger pipe may be furnished in standard cut-lengths of 20 feet or longer and be joined with approved couplings, provided that the installation of pipe less than full standard length in any run be limited to the needs for closure. All pipe and appurtenances shall be joined by means of approved flared type threaded couplings. The flaring of copper tubing ends shall be accomplished only with the use of proper size and type of tools as designed for the purpose, such as will provide accurate sizing and rounding of the ends. Tubing shall be cut squarely and all roughness shall be removed prior to flaring. All couplings shall be tightened securely, so the flared end fits snugly against the bevel of the fitting without leakage. The flared joint couplings shall be made up without the use of joint compound.

High Density Polyethylene (HDPE) service piping of 1 inch to and including 3 inches in diameter shall be installed in one piece without intermediate butt fusion, socket or electrofusion joint couplings between the main and the curb stop transition. For HDPE service pipe 4 inches and larger in diameter, the pipe may be furnished in standard cut-lengths of 40 feet or longer, provided that the installation of pipe less than full standard length in any run be limited to the needs for closure. All pipe and appurtenances shall be joined by means of butt fusion.

c. Service Connections to Main

Connection of seamless copper service lines to ductile iron water main shall be made with an approved corporation stop and saddle. Connection of seamless copper service lines to HDPE main shall be made with an approved electrofusion corp saddle and corporation stop. The water main tap shall be made at an angle of not more than 45 degrees from the horizontal. Service pipe may have a 45-degree bend connected to the corporation stop to bring the pipe to horizontal.

Connection of 2" and smaller HDPE service lines to HDPE water main 12" or smaller shall be made with an approved tapping tee with electrofusion saddle. Connection of 2" and smaller HDPE service lines to HDPE water main larger than 12" shall be made with an approved branch saddle. Connection of 3" and larger HDPE service lines to the HDPE water main of all sizes shall be made with branch saddle or tee. The water main tap shall be made at an angle of 90 degrees from the horizontal. The service pipe shall be butt fused to the tap fitting.

On HDPE main pipe 12" and larger, rounding clamps must be used for installation of all electrofusion saddles AND prior to electrofusion, all saddles shall be checked with a feeler gauge to ensure the gap between the saddle and the pipe is within the manufacturers tolerance.

Tapping of HDPE mains shall be performed using only an approved tapping tool designed specifically for the purpose of tapping HDPE pipe. Use of an electric drill with paddle bits or hole saws with serrated teeth for tapping is not allowed.

All taps into HDPE main shall be separated by a minimum of 2 pipe diameters or a minimum of 2 feet, whichever is greater. The distance shall be measured at the edge of the tapping saddle.

d. Curb Stop

The service pipe and curb stop coupling depth shall be such as to maintain not less than the specified minimum cover and provide for a standard service box installation where practicable. Curb stop shall be set on a concrete block. The service box shall be threaded over the curb stop coupling. Service boxes shall be installed plumb and be braced effectively to remain vertical during and after completion of backfilling. The service boxes shall be brought to existing surface grade when the final grade has not been established. When the final grade has been established, the Contractor shall extend the service box to finished grade.

The Contractor will furnish all materials except for the iron pipe for curb box stand pipes and caps (if necessary), which will be furnished by the City of Duluth Department of Public Works and Utilities. The Contractor shall be responsible for picking up the iron pipe at the City of Duluth Department of Public Works and Utilities facility located at 520 Garfield Avenue.

e. Coordination of Water Service Disruption

The Contractor shall notify property owners of the upcoming water service shutdown at least 24 hours prior to the shutdown.

13. Setting of Valves, Hydrants, Fittings and Specials

a. General

Valves, hydrants, fittings and specials shall be provided and installed as required by the Contract Drawings, Standard Details and Special Provisions, with the exact locations and setting being as directed by the Engineer, and with each installation being accomplished in accordance with the requirements for installation of mainline pipe to the extent applicable. Support blocking, reaction backing, and anchorage devices shall be provided as required by the Standard Details and this specification.

Hydrants shall be installed plumb, with the height and orientation of nozzles as shown in the Contract Drawings or as directed by the Engineer. Unless otherwise specified, the hydrants shall be connected to the mainline pipe with 6-inch diameter branch

pipe, controlled by an independent gate valve, and tied back to the tee with a hydrant holding tee or rodding as shown on the Standard Details.

All hydrants and valves shall have a minimum 12-pound bare zinc anode attached to one of the mechanical joint bolts.

Valve boxes shall be centered over the wrench nut of the valve and set on a valve box adapter bracket, and be installed plumb, with the box cover 3/8" below the surface of the finished pavement or at such other level as may be directed. Valve boxes shall not be installed so as to transmit shock or stress to the valve.

Masonry valve pit structures for valves, air vents or meters shall be constructed in accordance with the Standard Detail Drawing or plan details and with the applicable provisions of MN/DOT 2506.

Drainage branches, blow-offs, air vents, and other special appurtenances shall be closed with approved plugs or caps and shall be equipped with suitable blow-off facilities when specified.

All mechanical joint bolts used on all buried fittings, valves and hydrants shall have Cor-Ten or similar low corrosion bolts and nuts and 6 ounce zinc anode caps conforming to ASTM B-418.

The Contractor shall close the hydrant valve, install an end cap on the main and remove the hydrant and valve box.

This work shall consist of relocating hydrants after extending the hydrant leads as shown on the Contract Drawings or at a location outside of the roadbed as directed by the Engineer.

All additional materials furnished under this specification shall be new and like in kind to that in place.

Prior to installation, the hydrant, gate valve, fitting, and all related piping shall be cleaned of all foreign matter and after installation shall be disinfected in accordance with the procedures described in paragraphs No.'s 1227 and 1228 of Section XII "Manual of Water Supply Sanitation" of the Minnesota Department of Health.

b. Hydrant

This work shall consist of furnishing and installing a hydrant after extending the hydrant lead as shown on the Contract Drawings or at a new location outside the roadbed as directed by the Engineer. The work shall be performed in conformance with the applicable provisions of MN/DOT Standard Specifications and the current Standard Practices and Specifications of the City of Duluth. Hydrant construction requiring a new connection at the water main shall be performed by the Contractor. The Contractor shall furnish all materials and perform all piping work related to the new connection at the water main.

Where specified in the Plans, and prior to reinstalling, the hydrant drain valve shall be plugged if it is currently open and a tag affixed which states “NO DRAIN – Pump After Using.”

c. Butterfly Valve or Gate Valve and Box

This work shall consist of furnishing and installing a butterfly valve or gate valve and valve box in accordance with the applicable MN/DOT Standard Specifications, the City of Duluth Construction Standards, and as detailed in the Plan.

14. Adjust Valve Box

This work shall consist of adjusting existing water valve boxes to new surface elevations without changing the elevation of the valves.

- No adjusting rings shall be used unless approved by the Engineer. Adjustments shall be made prior to placing the final surfacing course unless otherwise approved by the Engineer.
- Pavement adjustment rings will only be allowed on pavement overlay projects where approved by the engineer. Where used on projects, only one may be used per valve box. All pavement adjustment rings shall be glued into place with a manufacturer recommended adhesive. The Contractor shall measure all valve boxes to determine the appropriate size of each adjustment ring.

When bituminous wearing course is to be held over to the next construction season, all valve boxes shall be adjusted to conform to 3/8 inch below the adjacent interim surface of the bituminous base or binder course prior to winter suspension.

15. Disinfection of 4 inch to 12 inch Ductile Iron Water Mains

Water mains 4" to and including 12" shall have chlorine tablets fixed in each pipe. While the water main is being laid, Calcium Hypochlorite tablets shall be attached to the inside top of each pipe using inorganic adhesive equal or similar to Permatex No. 1. Number of tablets per pipe segment shall be according to the table below to obtain at least a 25 ppm solution.

Pipe Length	Number of 5-Gram Tablets Required*				
	Diameter of Pipe				
	4"	6"	8"	10"	12"
Less than 13'	1	1	1	2	3
18'	1	1	2	3	4
20'	1	1	2	3	4

**Based on 3.25 grams of available chlorine per tablet.*

All pipe and fittings which must be disinfected prior to installation shall be thoroughly swabbed and brushed with a 1% hypochlorite (chlorine) solution or undiluted household bleach.

Procedure for Disinfection and Testing shall be as follows:

- a. Contractor shall fill the main under the direct observation of the Inspector or Engineer after notifying the Public Works and Utilities Department. Filling shall proceed slowly and stop when water begins to come out the end. Contractor shall provide a tap if the end of the main is not accessible. Do not flush test. Filled main shall sit for 24 hours to allow chlorine to work, or 48 hours if water is less than 41°F.
- b. Contractor shall flush main, hydrant branches, and any Blow-offs under the direct observation of the Inspector or Engineer. Department will arrange to have the City take chlorine test when flushing begins, and a bacteria-turbidity sample when flushing is complete.
- c. Upon passing a bacteria-turbidity test, the Contractor may arrange for a pressure test. The order of the bacteriological test and then the pressure test may be reversed only if the new section is completely disconnected from the city water system.
- d. Engineer will order main opened to system only after bacteria-turbidity test and pressure test pass. At all times prior to this, the new main shall be isolated by valving or other means except for filling, flushing, or taking samples. To insure against possible non-flow contact to the water system, it shall always be necessary to open the hydrant or blow-off before allowing system water to enter the new section.
- e. In the case of failed tests, the City reserves the right to charge the Contractor for retests.

16. Disinfection of 16 inch and Larger Ductile Iron Water Mains

Water mains with nominal diameters 16 inches and larger shall be disinfected by the Contractor. Procedure followed will be in accordance with AWWA C651-Section 5.2 whereby a constant flow of water is introduced simultaneously with a calculated and constant feed of chlorine solution into the main. When at least 25 ppm chlorine is measured at the opposite end, both water and chlorine feed shall be discontinued and the solution allowed to set in the pipe at least 24 hours. The Contractor will work intermediate valves and hydrants during the setting period, and will operate valve to introduce the water into the main under the supervision of the Department.

17. Cleaning and Disinfection of HDPE Water Mains

Prior to disinfection and testing, all HDPE water mains shall be pigged with a new foam pig to remove dirt, HDPE chips, curls and shavings. Water mains and branch lines less than 100 feet in length and water services are exempt from the pigging requirement, but the pipe shall be cleaned by other methods approved by the Engineer.

Procedure for disinfection shall be in accordance with AWWA C651-Section 5.2 whereby a constant feed of chlorine solution is introduced into the main while it is filled with water at a constant rate. When at least 25 ppm chlorine is measured at the opposite end, the chlorine feed shall be stopped and the solution be allowed to set in the pipe for at least 24 hours. The approximate amount of chlorine bleach required is summarized in the table below.

nominal pipe diameter	actual pipe diameter for HDPE DIPS SDR 11	gallons of water per 100 feet of pipe	gallons of bleach per 100 feet of pipe
4	3.876	61	0.03
6	5.571	127	0.06
8	7.305	218	0.10
10	8.961	328	0.16
12	10.656	463	0.22
Gallons of bleach are based upon an assumed 5.25% chlorine bleach concentration and a target concentration of 25 ppm.			

Calcium hypochlorite tablets or granules shall NOT be used for disinfection of HDPE mains or services.

Disinfection of HDPE pipes may be performed on temporarily capped pipes above grade prior to installation in the trench. Where this method is used, temporary caps must remain on the pipe during installation until the connection at each end is made. Temporary caps should include a method for filling and draining the water main.

18. Alternate Disinfection Procedures

When conditions preclude disinfection stated above, the Contractor may use the alternate procedure for disinfecting mains and branch services which consists of thoroughly swabbing pipe and brushing fittings with a 1% hypochlorite solution prior to installation. This method will only be considered acceptable with the prior written approval of the Engineer.

19. Testing Water Main and Services

a. Bacteriological Test

Sampling and testing for bacteria will be performed by the City. A test result will be provided after both 24 and 48 hours. Both tests must be passed. The Contractor shall be responsible for re-chlorination of the water main in the event the test result fails.

b. Pressure and Leakage Test

Following a passing bacteria test, the water mains shall be subjected to the pressure and leakage tests prescribed herein and in conformance with the pipe manufacturer's recommendations. The Contractor shall furnish the pump, pipe connections, gauges, and measuring equipment, and shall perform the testing under the direct observation of the Engineer.

The order of the bacteriological test and then the pressure test may be reversed only if the new section is completely disconnected from the city water system.

The Contractor may test each valved section, larger sections, or the entire water main so long as the elevation differential between the highest and lowest point does not exceed 110 feet.

All air must be expelled from the pipe. A hydrostatic pressure of not less than 150 pounds per square inch, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. Higher pressures may be specified in the project's Special Provisions.

The pump water container, and water used shall be disinfected prior to injecting water into the section of main.

For ductile iron mains, pressure shall be maintained for a minimum duration of 2 hours. No drop in pressure will be allowed for acceptance of the main.

For HDPE mains, fill the main slowly ensuring fill rate does not exceed capacity of air release devices. Once air has been expelled from the system, gradually raise the pressure to 160 psi. Add makeup water as necessary to maintain this pressure as necessary for 4 hours. After 4 hour period, reduce main pressure to the 150 psi test pressure and monitor for 1 hour. Do not increase pressure or add make-up water during this one hour period. The test is passed and considered acceptable if the main pressure does not drop more than 5% (7.5 psi) during the one hour period.

HDPE mains may be temporarily capped and tested above grade prior to installation in the trench. This method shall follow the procedure described above. In addition, there may be no visible leakage. When this method is used, a visual inspection of the connections at each end shall be made after the main is filled and prior to backfilling.

Any defective joints, pipe, fittings, valves, or hydrants revealed during the testing, or before final acceptance of the work, shall be satisfactorily corrected and the test shall be repeated until the specified requirement has been met.

Service tap valves and sleeves to be pressure tested with air or water before cutting out coupon.

Unless otherwise specified, services shall be tested for pressure and leakage by inspection of all exposed joints while under system pressure.

If specified for pressure testing, Service pipe may be tested at the time of the pressure test of the main, at the Contractor's option. Pressure testing of service pipes may also be completed as a separate operation from main pressure testing by applying a test pressure of 150 PSI.

The connection of services to HDPE water mains with an electrofusion corp saddle and corporation stop or a tapping tee with electrofusion saddle shall be soap tested and tested with air and accepted if it maintains 100 psig for 5 minutes. Accepted electrofusion corp saddle or tapping tee with electrofusion saddle can then be tapped to the main and the tap or punch tee cap reinstalled.

c. Electrical Continuity Test

For ductile iron pipe systems, the Contractor shall perform a continuity test between hydrants or any accessible point of the backfilled system. If the test shows no continuity, the Contractor shall find and repair the broken circuit. Megalug joint restraints shall not be used for electrical continuity.

For HDPE pipe systems, the Contractor shall perform a continuity test on all tracer wire after installation of pipe. If the test shows no continuity, the Contractor shall find and repair the broken tracer wire.

Pipe that fails to meet continuity requirements above will be considered unacceptable and no payment will be made.

d. Retesting

In the case of failed tests, the City reserves the right to charge the Contractor for retests.

20. HDPE Water Main Repairs on Existing Ductile Iron or Cast Iron Pipe

Where it is deemed convenient and appropriate to repair an existing water main with HDPE pipe, the following applies:

- a. All materials must meet the requirements of this Standard;
- b. For pipe repair length less than 10 feet, a tracer wire is NOT required;
- c. For a pipe repair length between 10 feet to 40 feet, provide tracer wire with one small (1 pound) anode stakes at each end of the repair and do not bring the tracer wire to grade;
- d. For a pipe repair length greater than 40 feet, provide tracer wire and one tracer box at each end of the repair and connect tracer wires to tracer boxes set at grade;
- e. For HDPE pipe repairs to existing cast iron hydrant leads, tracer wire is not required; and
- f. Whenever practical, pipe repairs (regardless of length) should be field located with 'survey grade' GPS equipment to update utility system maps.

C. Method of Measurement

Measurement for reconnecting a new water service to an existing water service will be measured per each by the number services reconnected.

Measurement for connecting to existing water main will be measured per each by the number of acceptable connections.

Hydrants will be measured per each by the number of complete units installed.

Hydrant relocation will be measured by the number of hydrants relocated as specified. Hydrant Assembly installation will be measured per each by the number of complete hydrant assemblies installed.

Adjusting existing valve boxes will be measured per each by the number of boxes adjusted.

Corporation stops of each size and type, except when already included under the Electrofusion Transition Service Saddle and Corporation Stop bid item, will be measured per each by the number of complete units installed.

Electrofusion transition service saddle and corporation stops of each size and type will be measured per each by the number of complete units installed.

Tapping tees with electrofusion saddle of each size and type will be measured per each by the number of complete units installed.

Curb stops and box of each size and type will be measured per each by the number of complete units installed.

Valves of each size and type will be measured separately per each as complete units, including the required valve box setting.

Tracer boxes of each type will be measured per each by the number of complete units installed.

Blow-off valve and fittings will be measured per each by the number of complete units installed, including the required manhole or vault castings, and covers.

Ductile iron fittings will be measured separately by the pound without joint accessories, and shall be the standard weight of fittings as published in AWWA C110. If the Contractor chooses to use compact ductile iron fittings in accordance with AWWA C153, the fittings shall be measured separately by the pound without joint accessories, and shall be the weight of fittings as published in AWWA C153. Or ductile iron fittings may be measured on per each basis as installed for each type of fitting used.

Mainline pipe and service pipe of each kind and size will be measured separately per linear foot by the overall length along the horizontal axis of the pipeline, from beginning to end of each installation and without regard to intervening valves or specials. Terminal points of measure will be the spigot or cut end, base of hub or bell end, center of valves or hydrants, intersecting centers of tee or wye branch service connections, and center of main to center of curb stop. Linear measurement of piping will include the running length of any special fitting (tees, wyes, bends, gates, etc.) installed within the line of measure between specified terminal points. No additional measurement will be made for extra pipe installed due to extra depth required for horizontal direction drilling applications. HDPE fittings are incidental to pipe installation and as such no measurement will be made.

Water service pipe will be measured by the horizontal length, in feet, from the center of the water main to the new curb stop.

Insulation will be measured by the area in square yards of polystyrene insulation board installed to the thickness specified.

D. Basis of Payment

Payment for construction of water distribution facilities will be made ONLY under the appropriate Contract Items at the Contract unit price; with all other costs of constructing the complete facility as required by Contract being incidental thereto the extent that the work does not qualify as an Extra Work Item.

Payment for Reconnect Existing Water Service and Connect to Existing Water Main shall be compensation in full for all costs incidental thereto including, but not limited to, all labor, equipment and materials for locating the existing water service or water main, furnishing and installing water main DI mechanical joint sleeves for reconnecting the HDPE water main to the existing CI water main, furnishing and installing fittings, adapters, transition couplings necessary to make a complete connection.

Payment for Hydrant and Relocate Hydrant shall be compensation in full for all costs incidental thereto including, but not limited to, any additional ductile iron pipe or HDPE hydrant leads, drain pits, blocking, crushed stone, extensions, risers, MJ to HDPE adapters, zinc anode bolt caps, 12-pound bare zinc anode, and fittings necessary to complete the installation.

Payment for Hydrant Assembly shall be compensation in full for all costs incidental thereto including, but not limited to, the hydrant, 6" gate valve and valve box, ductile iron pipe or HDPE hydrant lead, drain pits, blocking, crushed stone, extensions, risers, MJ to HDPE adapters, zinc anode bolt caps, 12-pound bare zinc anode, main line tee or fittings necessary to complete the installation.

Payment for Relocate Hydrant shall be compensation in full for all costs incidental thereto including, but not limited to, any additional ductile iron pipe or HDPE hydrant leads, drain pits, blocking, crushed stone, extensions, risers, MJ to HDPE adapters, zinc anode bolt caps, 12-pound bare zinc anode, main line tee or fittings necessary to complete the relocation.

Payment for Adjust Valve Box shall be compensation in full for all costs incidental thereto, including but not limited to, furnishing extensions as required and replacing any materials damaged by the Contractor's operations.

Payment for Corporation Stop, Electrofusion Transition Service Saddle and Corporation Stop, or Tapping Tee with Electrofusion Saddle shall be compensation in full for all material, labor and equipment necessary to complete the work as described herein including tapping the water main, furnishing and installing the connection fittings on the main and butt fusing the HDPE water service pipe to the tapping tee with electrofusion saddle.

Payment for Curb Stop and Box shall be compensation in full for all materials, labor and equipment necessary to install the curb box and furnish and install the curb stop and any transition fittings necessary to connect new HDPE water service pipe to the curb stop.

Payment for Butterfly Valve and Box or Gate Valve and Box shall be compensation in full for all costs incidental thereto to furnish and install the valve and valve box complete and in place, including but not limited to the valve and valve box, blocking, MJ to HDPE adapters, zinc anode bolt caps, 12-pound bare zinc anode, and crushed stone. No additional payment will be made for valves installed where new mains are deeper than the minimum depth.

Payment for Water Tracer Box shall be compensation in full for all materials, labor and equipment necessary to furnish and install the tracer box.

Payment for Blow-offs shall be compensation in full for all costs of furnishing and installing the necessary materials complete in place as specified, including all costs of excavation, bedding, backfill, pipe, tapping main, valves, curb stops, caps, blocking, castings, valve box, tracer wire, and necessary adapters or transition couplings, and other work necessary to complete the work.

Payment for Ductile Iron Fittings for water main shall be compensation in full for all costs of providing the necessary materials complete in place as specified including, but not limited to, furnishing and installing reducers, tees, crosses, bends, plugs, and other work necessary to complete the work.

Payment for Water Service Pipe shall be compensation in full for all labor, equipment, and materials costs of furnishing and installing the pipe complete in place including, but not limited to, trench excavation, foundation preparation, bedding, placement and compaction of encasement materials, coarse filter aggregate, placement and compaction of backfill, cleaning, disinfection, bacteria testing, leakage testing, tracer wire, continuity testing, fittings, hardware, zinc anode bolt caps, 12-pound bare zinc anode, MJ adapters, transition couplings, blocking and anchorage materials, and other work necessary to complete the work. No payment shall be made for water service pipe with a tracer wire that has not passed an electrical continuity test.

Payment for Water Main Ductile Iron (class) shall be compensation in full for all labor, equipment, and materials costs of furnishing and installing ductile iron water main complete in place including, but not limited to, trench excavation, foundation preparation, bedding, polyethylene encasement, placement and compaction of pipe encasement materials, placement and compaction of backfill, cleaning, disinfection, bacteria testing, leakage testing, continuity testing, fittings, hardware, zinc anode bolt caps, transition couplings, blocking and anchorage materials, and other work necessary to complete the work. No payment shall be made for ductile iron water main pipe that has not passed an electrical continuity test.

Payment for HDPE Water Main SDR 11 shall be compensation in full for all labor, equipment, and materials costs of furnishing and installing HDPE water main including, but not limited to, trench excavation, foundation preparation, bedding, placement and compaction of pipe encasement materials, placement and compaction of backfill, cleaning, disinfection, bacteria

testing, leakage testing, tracer wire, continuity testing, HDPE by MJ adapters, HDPE to cast iron transition couplings, fittings, hardware, zinc anode caps, blocking and anchorage materials, and other work necessary to complete the work. All costs of furnishing and installing electrofusion flex restraints and concrete collars on the HDPE Water Main shall be considered incidental to the water main. No payment shall be made for water main pipe with a tracer wire that has not passed an electrical continuity test.

Payment for Polystyrene Insulation shall be compensation in full for all costs incidental thereto including, but not limited to, the extra trench excavation, furnishing and placing polystyrene insulation board, granular backfill, and off-site disposal excess excavated material.

Payment for water main and service construction will generally be made on the basis of the following schedule:

<u>Item</u>	<u>Description</u>	<u>Unit</u>
2504.602	Reconnect Water Service	Each
2504.602	Connect to Existing Water Main	Each
2504.602	Hydrant	Each
2504.602	Relocate Hydrant	Each
2504.602	Hydrant Assembly	Each
2504.602	Adjust Valve Box	Each
2504.602	(size)" Corporation Stop	Each
2504.602	(main size)"x(service size)" Electrofusion Transition Service Saddle and Corporation Stop	Each
2504.602	(main size)"x(service size)" Tapping Tee w/Electrofusion Saddle	Each
2504.602	(size)" Curb Stop and Box	Each
2504.602	(size)" Butterfly Valve and Box	Each
2504.602	(size)" Gate Valve and Box	Each
2504.602	Water Tracer Box	Each
2504.602	Blow-Off	Each
2504.602	(size) Ductile Iron (fitting type)	Each
2504.603	(size)" Type K Copper Service Pipe	Linear Foot
2504.603	(size)" HDPE SDR 11 Service Pipe	Linear Foot
2504.603	(size)" Water Main Ductile Iron (class)	Linear Foot
2504.603	(size)" DIPS HDPE Water Main SDR 11	Linear Foot
2504.603	(size)" DIPS HDPE Water Main SDR 11 (Horizontal Directional Drill)	Linear Foot
2504.604	3" Polystyrene Insulation	Square Yard
2504.608	Ductile Iron Fittings	Pound

2504 CONCRETE ENCASED VALVE BOX COLLAR

This work shall consist of vertical adjustment, leveling, and place concrete encasement collar around valve box castings in accordance with the City of Duluth Standard Specifications, the Plan details, and the following provisions:

A. Description

The adjust valve box work shall consist of: cutting and extracting the pavement and base section in a circular layout around the perimeter of the manhole; installing the valve box casting assembly; and placing a reinforced concrete encasement collar around the casting frame to match the adjacent pavement grades.

B. Materials

- 1) Reinforcement for encasement collar shall epoxy coated in accordance with MN/DOT 3301.
- 2) Concrete for encasement collar shall be **Mix No. 3G52** in accordance with MN/DOT 2301 and MN/DOT 2461 (refer to Appendix E of these standards).

C. Construction Requirements

1) Pavement Removal and Preparation

- a. Precautions must be taken to prevent debris from entering the valve box during the entire removal and reconstruction process.
- b. Cut and remove the asphalt pavement structure, around the valve box casting, with a rotating cutter device that creates a circle with a minimum diameter of 32" and centered about the casting. For all "shallow" valve installations, remove centering pin or provide "short" centering pin, so that the valve is not damaged during cutting operation. Remove and dispose of the asphalt off-site.
- c. Remove the upper section casting and cover from the top of the valve box. Inspect the valve box section and cover for defects. If defects are present, replace with a new valve box/cover as needed. If defects are not present, clean & retain for use in reconstruction.
- d. Remove all aggregate around the valve box that has been exposed by the asphalt removal and dispose of this aggregate. The aggregate must be removed to a minimum of **12"** below the level of the top finished pavement surface.
- e. Reset the top valve box section and adjust the top of the casting so that it shall be exactly **0.25 inch below flush** with the pavement surface in all directions.
- f. Place the cover/lid on the valve box casting to lessen the possibility of debris entering the manhole.

2) Concrete Encasement Collar Installation

- a. Place epoxy coated reinforcement around casting frame adequately supported to hold position during concrete placement.
- b. Place concrete encasement collar in accordance with reference standards.

- c. The surface of the concrete shall be finished from flush with the pavement to flush with the rim casting. The edge of the concrete shall be rounded (1/4" radius) where it meets the asphalt.
- d. Fill the groove with a cold pour crack sealer. This will prevent water from entering the circular seam where the concrete collar meets the asphalt.
- e. Apply a concrete curing and sealing compound to the surface of the concrete collar.
- f. Protect concrete from loading & vibration until the concrete attains a compressive strength of 3,000 psi.

D. Measurement and Payment

Measurement will be made for each structure completed as specified. Payment will be made under Item 2504.602 (Concrete Encased Valve Box Collar) at the Contract bid price per each, which shall be compensation in full for all labor, equipment, and materials necessary to complete the work.

2504 TEMPORARY WATER SERVICE

Revised 1/28/19

The provisions of MN/DOT 2504 and the City of Duluth Standard Specifications are supplemented with the following:

A. Description

This work shall consist of providing a temporary water service system to adjacent residents and businesses in accordance with the Plans, the City of Duluth Standard Specifications & Details, and as directed by the Engineer.

B. Construction Requirements

Temporary water main pipe shall be 2" or 3" HDPE SDR 11 pipe or as shown on the contract drawings. Temporary water service pipe shall be 3/4" or 1" HDPE pipe to within 5 feet of the hose bib or building connection or as shown on the contract drawings. Final connection to residential homes may be made with a hose rated for potable water (RV water supply hose). All HDPE connections shall be butt fused or fused fittings, no band clamps will be allowed. Pressure reducing valves shall be provided (when necessary) to control the water pressure of the temporary water service system to a maximum pressure of 80 psi at the house. Fittings and restraints (when necessary) shall be in accordance with City of Duluth Standards. End caps shall be installed on all temporary water service system pipes when moving the pipe on the ground.

All temporary water service system components shall meet requirements of City of Duluth Standards for pipe cleaning, bacteria, and pressure & leakage testing. Temporary water mains 6 inch and larger shall be pigged prior to disinfection. All services shall be disinfected with temporary main and flushed individually. Temporary water service system shall be fully operational and achieve passing test results prior to disconnection of the existing water main. Where pipe is reused from previous stages of construction, it shall be cleaned and completely

retested prior to use as a temporary water service system. All temporary water service system pipes shall be protected from construction equipment and local vehicle traffic.

C. Submittals and Coordination

The Contractor shall prepare and submit a Temporary Water Service Installation Plan to Engineer at least 14 days prior to installation. The Plan shall include: planned construction, staging & schedule; connection points; proposed tie-ins; existing hydrants & shut-off valves; temporary pipe size & materials information; and emergency contact information. Emergency information shall include the name and phone number of at least two personnel available 24 hours per day 7 days a week. Emergency contact personnel shall be familiar with the project and have the authority to make repairs to the temporary water service system within 8 hours of notification from resident. The Contractor shall furnish and deliver emergency contact information "door hangers" to all residents at least 48 hours prior to connecting to the temporary water supply system. The Contractor shall attend a mandatory pre-installation coordination meeting with the Engineer prior to beginning temporary water service system work.

D. Measurement and Payment

No measurement will be made of the various Items that constitute Temporary Water Service but furnishing all such items as specified will be construed to be included in the single Lump Sum payment under Item 2504.601 (Temporary Water Service). Such payment shall be considered full compensation for all costs for labor, equipment, and materials associated with installation, testing, protection, maintenance, removal, and restoration.

2503/2504/2505 HORIZONTAL DIRECTIONAL DRILLING

A. General

This work shall consist of the installation of an underground pipe using the horizontal directional drilling method indicated on the Contract Drawings. Products installed under this section include Pressure Sewer Pipe and Forcemain, Pressure Sanitary Sewer Services, Water Main Pipe and Fittings, Water Services, Gas Main Pipe and Fittings, Gas Service Pipe and Fittings, and Special Connections.

1. Definitions

a. Horizontal Directional Drilling (HDD)

Method of trenchless construction producing continuous bores, using a surface launched, remotely steerable, electronically monitored drilling tool controlled from a mobile drilling frame, and including a field power unit, mud mixing, storage and recycling system, and mobile spoils extraction system.

b. HDD Subcontractor

Firm engaged in the construction of underground sanitary sewer, water or gas lines and with demonstrated competency using HDD methods of installation of pipe.

2. System Description

The drilling system differs from the micro-tunneling, auger boring or pipe jacking equipment in that operations are performed from the surface; large pits to place and align

equipment are not necessary. The drilling frame is sited and aligned to bore a pilot tunnel that conforms to the planned line and grade of pipe. The drilling frame is typically set back from an access pit that has been dug at the location of a tie-in, connection, manhole (or other appurtenance), or other location; and a high pressure/low volume fluid-jet toolhead that uses an inert, environmentally acceptable mixture of bentonite clay and water is launched and guided to the correct invert elevation and line required at the manhole (or other appurtenance). This is called the pilot hole. A real-time guidance system is attached behind or within the toolhead to measure inclination, roll and azimuth. Upon reaching the receiving pit, the toolhead is removed and a reamer with the product pipe attached is joined to the drill string and pulled back through the tunnel created by the pilot hole. For some pipe sizes and soil conditions, the Contractor may also introduce cement into the stabilizing mud mix. A vacuum spoils extraction system removes any excess spoils generated during the installation.

3. Performance Requirements

- a. Contractor shall provide a horizontal directional drilling system compatible with the subsurface conditions and the size, type, depths and lengths of pipe to be installed.
- b. Contractor shall provide all labor, materials, equipment and incidentals necessary to install pipe by horizontal directional drilling as shown on the Drawings and as specified herein.
- c. Contractor shall provide all survey layout, inspection and record-keeping incidental to the drilling pipe installation.
- d. This procedure is applicable to the installation of sanitary sewer and sewer services, water main and water services and gas main and gas services.

4. Submittals

- a. Submit product data for the drilling fluid including a description of the following items:
 - Manufacturer
 - Components
 - Special Precautions
 - Manufacturers recommended method of mixing and application
 - Manufacturers recommendation for storage and handling
 - Material Safety Data Sheet (MSDS)
- b. Certificate of Compliance
Submit Certificates of Compliance for products and materials.
- c. Equipment and Construction Procedures
Submit working drawings, manufacturer's data sheets and written procedures describing in detail the equipment, tools and materials to be used along with the proposed method of product pipe staging and installation. This will include, but not be limited to, size, capacity and setup requirements of equipment; location and sizing of drilling and receiving pits; dewatering if applicable; type of cutting tool head; back-reaming tool types and sizes; method of monitoring and controlling line and grade; locations and sizes of product jointing and staging areas; type of equipment for joining pipe; and time requirements of joint fusion. The Contractor shall detail a description

of line and grade control and a viable method to eliminate accumulative error due to the inclinometer (pitch or accelerometer) and demonstrate that method in the field prior to commencing drilling operations.

- Grouting techniques to be used for over-excavation, if any, including equipment, pumping procedures, grout types and mixtures.
- Proposed procedures, materials and equipment for lubricating the exterior of the pipe during pulling.
- Details of spoil removal system, including equipment type, number and disposal location.
- Proposed methods, materials and equipment for removing and clearing obstructions so that the HDD can advance forward.
- Furnish compliance submittals showing all fabrication and construction details for the directional drilling installation of the pipe.

The Contractor shall submit a construction schedule with starting and completion dates for each of the procedure tasks.

If the Contractor determines that modifications to the methods and equipment as stated in the submittal are necessary during construction, the Contractor shall submit a revised plan.

d. Contractor Qualifications

- Submit the documentation showing five years of HDD and references for at least three jobs of similar magnitude and detail completed within the past five years. Information must include, but is not limited to, date and duration of work, location, pipe information, project owner information (including a name and phone number), and the contents of the pipeline.
- Submit references for any subcontractors that may be used on site.

e. Record Drawings:

After completion of pilot hole drilling, submit tabulation of pilot hole coordinates as required under "Pilot Hole" paragraph below.

5. Qualifications of the Directional Drilling Contractor

The HDD contractor shall be trained and certified to operate the Horizontal Directional Drilling equipment with at least five years of experience in directional drilling, obtained over the last five years. Perform HDD operations under the constant direction of a drilling supervisor who shall remain on site and be in responsible charge throughout the drilling operation. The supervisor shall have supervised directional drilling and a minimum of 10,000 linear feet of pipe. Submit a list of field supervisory personnel and boring machine operator(s) and their experience with HDD operations. At least one of the field supervisors listed must be at the site and responsible for all work at all times when HDD operations are in progress, and both that person and the HDD machine operator shall have been employed with the HDD specialty contractor for a minimum continuous period of one year immediately prior to this work. HDD specialty subcontractor shall not

mobilize to the site until the resumé of the Contractor's field supervisory personnel and boring machine operator have been reviewed by the Engineer.

6. Delivery, Storage and Handling
Check the materials upon delivery to assure that proper material has been received. Store drilling fluid components in accordance with manufacturer's recommendations and out of the effects of inclement weather.
 7. Materials
Bentonite for drilling fluid shall be high quality Wyoming bentonite composed primarily of sodium montmorillonite.
 8. Drilling Site
Additional work space and access may be acquired by Contractor only with approval of Owner and applicable property owners. Expense of acquiring additional work space shall be borne by Contractor. Site access, clearing, grading, and preparation necessary for construction operations shall be performed as required.
 9. Quality Assurance
Fusing of polyethylene pipe shall be done by qualified fusers. Certification of personnel and fusing of pipe shall comply with the requirements for gas lines in the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe.
 10. Drilling Equipment
For natural gas installations, the drilling head must be equipped with a sonde which meets the requirements of the Minnesota Office of Pipeline Safety when drilling near sanitary sewer laterals.
- B. Products
1. Carrier Piping
Carrier piping shall be as specified in 2503 PIPE SEWER - PRESSURE, 2504 WATER MAIN AND SERVICE LINE INSTALLATION or the 2015 Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe (Gas Operations and Maintenance Manual – Section 14 through Section 29).

The pressure rating specified for the carrier pipe in their respective specifications sections shall be considered a minimum. Provide a higher class of pipe if required by the loads imposed by pulling operation.
 2. Drilling Fluids
Drilling fluid composition shall meet permit requirements and environmental regulations.
 3. Water
Contractor shall procure, transport, and store water as required for his operations.

4. Locating Wire

Locating (tracer) wire shall be as specified in 2503/2504 LOCATING WIRE FOR WATER AND SEWER.

C. Execution

1. Joining Pipe

Pipe fusing shall be done by qualified fusers. Certification of personnel and fusing of pipe shall comply with the requirements for gas lines in the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe, included in these specifications. All sanitary sewer main and water main shall be butt fused. Sanitary sewer and water branch or tap service pipe of any diameter shall also be butt fused.

2. Monitoring

Contractor shall at all times provide and maintain instrumentation which will accurately locate pilot hole position in X, Y, and Z axis relative to ground surface. Drilling fluid flow rate and pressure shall also be monitored. Engineer and Owner shall have access to this data at all times during the operation.

The City of Duluth gas utility must be notified 2 working days prior to any excavation or directional drilling within 6 feet of a 6 inch or larger natural gas main. Department personnel will be on site to monitor excavation and inspect any exposed steel main 6 inches or larger. Notify the Engineering Division at 730-5200 to coordinate this inspection.

The Contractor shall notify the Engineer immediately any time a steel natural gas main smaller than 6 inches is exposed within an excavation. Contact the Engineering Division at 730-5200 to coordinate an inspection of the exposed main.

Prior to the start of any directional drilling, the Contractor shall pothole all proposed utility and service line crossing locations to confirm the depth of the main. The Contractor shall maintain the excavation or reopen the excavation to verify that pilot hole, pre-reaming, and back-reaming drilling operations did not interfere or damage existing facilities. In addition to all crossing facilities either shown on the Plans and/or as located in the field as a result of the GSOC locate request, the Contractor should anticipate potholing for crossing private water, sewer and gas services to homes and businesses. All costs associated with monitoring shall be incidental to pertinent pipe bid items.

3. Pilot Hole

A pilot hole shall be drilled along the path shown on Drawings to the following tolerances:

- a. Elevation: Plus 0.5 feet, minus 0.5 feet for low pressure sanitary sewer and plus 0 feet, minus 1 foot for water main and gas main.
- b. Alignment: Plus or minus 1 foot for low pressure sanitary sewer and plus or minus 2 feet for water main and gas main.
- c. Curve Radius: minimum 250 feet or pipe manufacturer's recommendation, whichever is greater.

- d. Entry Point: At the location shown on Drawings.
- e. Exit Point: Pilot hole shall penetrate ground surface within plus or minus 10 feet of alignment shown on Drawings and within plus 20 feet and minus 0 feet of length shown on Drawings. In all cases, pipe shall remain within easement and right-of-way areas.

Contractor shall plot actual horizontal and vertical alignment of pilot bore at intervals not exceeding 25 feet for low pressure sanitary sewer and 50 feet for water main and gas main. This “as-built” plan and profile shall be updated as pilot bore is advanced.

In all cases, right-of-way restrictions shall take precedence over the tolerances listed above. Regardless of the tolerance achieved, no pilot hole will be accepted if it will result in any or all of pipeline being installed in violation of right-of-way restrictions. In all cases, concern for adjacent utilities and structures shall take precedent over the tolerances listed above. Specification of tolerances does not relieve Contractor from responsibility for safe operations or damage to adjacent utilities and structures.

After completion of pilot hole drilling, Contractor shall provide a tabulation of coordinates to Engineer, referenced to drilling entry point, which accurately describes location of pilot hole.

4. Reaming and Casing Pipe Pull-Back Operation

General: Upon completion of pilot hole drilling, hole shall be enlarged by reaming and preassembled pipeline pull section shall be installed in hole. Pipeline shall be preassembled to provide one continuous pulling operation. Pipeline shall be temporarily capped before pulling operations to prevent any drilling fluid, water, or debris from entering pipeline.

Prereaming: Prereaming operations shall be conducted at discretion of Contractor. All provisions of this specification relating to simultaneous reaming and pulling back operations shall also pertain to prereaming operations.

Backreaming: Backreamer must be of large enough diameter to insure a competent tracer wire can also be pulled back with the pipe.

Pulling Loads: The maximum allowable tensile load imposed on the pipeline pull section and **used for setting weak-link devices** for polyethylene pipe shall be in accordance with ASTM F 1804 “Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation.” The maximum allowable tensile loads for polyethylene pipe shall be within the values shown in the following table for pull durations up to 12 hours and material temperature of 100°F. For longer pull durations or higher pipe material temperatures, these values will be recalculated by the Engineer. If more than one value is involved for a given pull section, the lesser value shall govern. The Contractor shall maintain accurate records of pull forces at all times for review by the Engineer. The “weak link” may be a pulling head or next smaller diameter pipe (same SDR) than the pipe being pulled.

MAXIMUM ALLOWABLE TENSILE LOAD FOR MDPE AND HDPE PIPE

(material temperature @ 100°F, pipe under tension ≤ 12 hours)

NATURAL GAS PIPE (MDPE)			WATER & SEWER PIPE (HDPE)		
SIZE	SDR	LBS.	SIZE	SDR	LBS.
1/2" CTS	7.0	135	3/4" IPS	9.0	367
1" CTS	9.3	343	1" IPS	9.0	582
			1 1/4" IPS	9.0	925
			1 1/2" IPS	9.0	1,213
2" IPS	11.0	1,316	2" IPS	9.0	1,892
3" IPS	11.5	2,746	3" IPS	9.0	4,103
4" IPS	11.5	4,539	4" DIPS	11.0	6,472
6" IPS	11.5	9,839	6" DIPS	11.0	13,374
8" IPS	11.5	16,675	8" DIPS	11.0	23,003
			10" DIPS	11.0	34,607
12" IPS	11.0 *	46,673	12" DIPS	11.0	48,940
			14" DIPS	11.0	65,749
			16" DIPS	11.0	85,036
			20" DIPS	11.0	131,041
* HDPE pipe for 12" IPS gas main only			24" DIPS	11.0	186,968

Torsional Stress: A swivel shall be used to connect pipeline pull section to reaming assembly to minimize torsional stress imposed on section.

Pull Section Support: Pull section shall be supported as it proceeds during pull-back so that it moves freely and pipe is not damaged.

External Collapse Pressure: Pull section shall be installed in reamed hole in such a manner that external pressures are minimized. Any damage to pipe resulting from external pressure during installation shall be the responsibility of Contractor.

Buoyancy Modification: Buoyancy modification shall be used at the discretion of Contractor. Any buoyancy modification procedure proposed for use shall be submitted to Engineer for acceptance. No procedure may be used which has not been reviewed by Engineer. Contractor will be responsible for any damage to the pipeline resulting from buoyancy modification.

5. Drilling Fluids

General: Drilling fluids shall be in compliance with environmental regulations.

Recirculation: Contractor shall employ his best efforts to minimize excess drilling fluid by recirculating surface returns. This shall include, but not be limited to, provision of a solids control system sized and configured to remove spoil from drilling fluid surface returns so that fluid may be returned to active system without hindering drilling progress.

Inadvertent Returns: Contractor shall employ his best efforts to maintain full annular circulation of drilling fluids. Drilling fluid returns at locations other than entry and exit points shall be minimized. In the event that annular circulation is lost, Contractor shall take steps to restore circulation. If inadvertent surface returns of drilling fluids occur, they shall be immediately contained with hand placed barriers (hay bales, sandbags, silt fences, etc.), and collected using pumps, where practicable. If amount of surface return is not great enough to be collected, affected area shall be flushed with fresh water and fluid shall be allowed to dry and dissipate naturally. If amount of surface return exceeds that which can be contained with hand-placed barriers, small collection sumps (less than 5 cubic yards) may be used. If amount of surface return exceeds that which can be contained and collected in small sumps, drilling operations shall be suspended until surface return volumes can be brought under control. Clean-up of inadvertent returns shall be the responsibility of Contractor.

Disposal: Disposal of excess drilling fluids and spoil shall be the responsibility of Contractor and shall be conducted in compliance with environmental regulations, right-of-way and workspace agreements, and permit requirements. Drilling fluid and spoil disposal procedures proposed for use shall be submitted to Engineer for acceptance. No procedure may be used which has not been reviewed by Engineer.

6. Damage to Surfaces

The contractor will be responsible for restoration of damage caused by drilling, pulling pipe or drilling equipment to surrounding street, parking lot and driveway pavement, sidewalk and curb and gutter and turf by the contractor's equipment at no cost to the Department.

7. Locating Wire

The locating wires shall be pulled along with the pipe. **The Contractor must pull a minimum of two (2) wires in the event one locating wire does not pass the continuity test.** Wire shall meet the provisions of 2503/2504 Locating Wire for Water and Sewer of this Standard. The Contractor shall be responsible for the installation of a locating wire with electrical continuity throughout the entire length. The locating wire shall be made accessible as shown on the Standard Details or the Contract Drawings. The cost of furnishing and placing locating wire shall be considered incidental to the pipe.

D. Testing

1. Pressure and Leakage Test

Pressure and leak test of carrier piping shall be as specified in 2503 PIPE SEWER - PRESSURE, 2504 WATER MAIN AND SERVICE LINE INSTALLATION or the current version of the City of Duluth Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe, included in these specifications.

2. Testing Locating Wire Continuity

Test locating wire continuity after installation of each section of continuous tracer wire. The Contractor shall be responsible for the installation of at least one locating wire with electrical continuity throughout the entire length. No payment shall be made for a pipe with a tracer wire that has not passed a continuity test.

E. Measurement and Payment

Pipe placed by horizontal directional drilling shall be paid for under the applicable utility. No payment shall be made for a pipe with a tracer wire that has not passed a continuity test.

2505 ADJUST VALVE BOX - GAS

All work performed around existing gas mains shall be in accordance with the provisions of the Standard Specifications for High Pressure Gas Mains, Transmission Line, and Service Installation, Welding Qualifications and Qualifications for Joining PE Pipe (Appendix A), included in these specifications, except as modified herein.

A. Construction Requirements

1. Adjust Valve Box

This work shall consist of adjusting existing gas valve boxes to new surface elevations without changing the elevation of the valves.

2. Replacement Valve Boxes

The Contractor shall take care to salvage existing valve boxes for reuse. If the Engineer determines that the existing valve box is too badly deteriorated to be reused, the Engineer will provide a replacement valve box for the contractor to install.

B. Measurement and Payment

Measurement for adjust valve box will be by the number of gas valve boxes adjusted to final grade. Payment for adjust gas valve box will be made item 2505.602 (Adjust Valve Box – Gas) at the contract price per each, which shall be compensation in full for all labor, materials, and equipment to complete the work.

2506 MANHOLES AND CATCH BASINS

Manhole and Catch Basin construction and reconstruction, both storm and sanitary, shall be performed in accordance with the provisions of MN/DOT 2506, except as modified below:

A. Materials

1. Sanitary Manholes

All sanitary manholes, air-release manholes and cleanout manholes shall meet the requirements of **City Standard Detail SAN-11**. The Contractor shall be responsible for providing openings in the manhole section at the proper locations according to the contract drawings. A 27-inch nominal diameter opening shall be provided in the cone. Unless otherwise shown in the City Standard Details or Plans, the cone sections shall be **concentric**. No steps will be allowed in the manholes. Manhole structures shall be sectional precast concrete manhole units conforming to the requirements of MN/DOT 3622. "O" ring gaskets conforming to MN/DOT 3726 shall be used in the joints in the barrel sections. All manholes must have **integral concrete base**. Manhole flexible sleeves for sanitary manholes shall be NPC Kor-N-Seal1, Press Seal PSX Direct Drive, Z-Lok Boot Connector, or approved equal. All pipe sleeves must be water tight.

2. Storm Manholes and Catch Basins

Storm sewer structures shall be sectional precast concrete manhole units conforming to the requirements of MN/DOT 3622 and the current version of MN/DOT Standard Plates 4005 (Design F), 4006 (Design G), 4020, or 4024 (Type SD). A 27-inch nominal diameter opening shall be provided in the cone or flat top cover. Unless otherwise shown in the Plans, the cone sections shall be **concentric** and openings in flat top covers shall be **centered**. "O" ring gaskets conforming to MN/DOT 3726 shall be used in the joints in the barrel sections. No steps will be allowed in the manholes.

3. Catch Basin Castings

Catch basin frame castings shall conform to **City Standard Details STRM-2, STRM-2B, STRM-3, STRM-3A and STRM-3B**. Catch basin grate castings shall be 814A on MN/DOT Standard Plate 4152; or 816 on MN/DOT Standard Plate 4154. Catch basin curb box castings shall be 823A on MN/DOT Standard Plate 4160. Unless otherwise noted in the project Special Provisions, catch basin castings shall be supplied by the Contractor.

Catch basin frame and grate castings for existing structure maintenance repairs by CITY CREWS (ONLY) shall be Neenah R-3349-A or Neenah R-3250-BSP4. These are not acceptable for new structures.

4. Manhole Castings

Manhole Casting Assemblies with lids shall conform to **City Standard Details SAN-1 and STRM-1** for sanitary and storm manholes. Unless otherwise noted in the project Special Provisions, manhole castings shall be supplied by the Contractor.

5. Manhole Adjustment Rings

Except where concrete encased casting collar is required in the Plans, the manhole adjusting rings shall be molded from high-density polyethylene as defined in ASTM D-1248. The complete adjustment system utilizing the HDPE rings shall consist of the rings, sealed to the manhole structure, casting and one another by means of an approved butyl sealant. The Contractor shall utilize a combination of "wedge" rings and "flat" rings to achieve proper slope of the casting. Shims shall not be used. Concrete adjustment rings shall not be used.

6. Casting Extensions

Casting Extensions shall be Neenah R-1979 or ESS Brothers paving adjustment ring. Extensions shall be cast iron.

7. Non-Shrink Grout or Cement-Base Polymer Modified Patching and Repair Mortar

Non-shrink grout shall be a non-metallic type grout which is durable in wetting and drying, freezing and thawing conditions and shall conform to the requirements set forth in ASTM C 1107-01. Cement-based polymer modified patching mortar shall conform to the requirements set forth in ASTM C 109, ASTM C 490-77, and ASTM C 807-83 (modified).

8. Bedding

Manholes and Catch Basins shall be bedded on granular material meeting MN/DOT 3149.2.H Coarse Filter Aggregate.

9. Structure Backfill

Unless otherwise noted in the Plans, or directed by the Engineer, manholes and catch basins shall be backfilled with granular material meeting MN/DOT 3149.2.D.1 Granular Backfill.

10. Sanitary Casting Sealant

DOW Corning 700 Industrial Grade (Clear) sealant shall be provided between manhole cover and casting frame to create an 'airtight' seal for all WLSSD manholes and City manholes where directed by the Engineer.

B. Construction Requirements

1. Manholes and Catch Basins shall be bedded on 6-inches of Coarse Filter Aggregate.
2. When using plastic pipe, manhole water stops supplied by the manufacturer shall be installed.
3. All annular wall space surrounding the in place pipes shall be completely filled with mortar or concrete and the inside bottom of each manhole shall be shaped with fresh concrete to form free flow through invert troughs as directed. The troughs shall be as deep as a half-pipe and the shelves shall slope up 3 inches from the trough to the wall.
4. When a sewer connects with an existing manhole or catch basin, the Contractor shall make a suitable connection through the wall of the manhole or catch basin and shall reshape the invert to assure a smooth and unobstructed flow line through. All pipe connections to existing manholes shall be water tight.
5. Non-shrink grout or cement-based polymer modified patching mortar shall be used to patch lifting holes in manholes and catch basins.
6. The Contractor shall utilize a combination of flat and sloping manhole adjustment rings to adjust the casting to the slope and grade as specified below.
7. Manhole casting assemblies with lids shall be installed in accordance with Standard Details SAN-3, SAN-3A, STRM-5, and STRM-5A. The straightedge will be placed across the center of the casting and will touch both sides of the pavement. The measurement will be taken at the center of the casting. Castings that are measured at more than 3/8 inch below the pavement prior to final acceptance of the project will be raised to the prescribed depth of 3/8 inch. All costs associated with this corrective action will be assumed by the contractor.
8. Casting Extensions shall only be used where approved by the engineer on pavement overlay projects. Casting extensions shall not be used to adjust incorrectly installed manhole castings. Where casting extensions are installed, only one may be used per casting to achieve the proper height adjustment. All casting extensions shall be glued into place with a manufacturer recommended adhesive. The Contractor shall measure all manhole castings to determine the appropriate size of each casting extension.
9. All sanitary manholes must pass a vacuum test as specified elsewhere in this specification. Any manholes which do not pass the vacuum test or have visible leakage within the manhole will not be accepted.
10. All storm manhole castings and catch basin castings shall be wrapped with geotextile fabric as shown on the standard details.
11. Manhole and catch basin structures shall not be placed over/above water, gas, sanitary, or storm pipes.

C. Basis of Payment

Payment for Drainage Structures, Manholes and Catch Basins shall be at the contract unit price per unit of measure and shall include, in addition to the MN/DOT 2506.5 Basis of Payment, furnishing and placing granular materials for bedding and structure backfill.

2506 CONCRETE ENCASED CASTING COLLAR

This work shall consist of vertical adjustment, leveling, and place concrete encasement collar around manhole castings in accordance with MN/DOT 2506 and the following provisions:

A. Description

The process for adjusting manhole frame and ring castings to finish grade shall be done by utilizing a pipe adjustment ring for temporary support and a concrete pavement encasement collar. The adjustment pipe and concrete collar system shall consist of providing a temporary cover plate prior to paving; cutting and extracting the pavement and base section in a circular layout around the perimeter of the manhole; installing a watertight PVC pipe adjusting ring (casting support) on top of the manhole structure; installing the manhole frame and casting assembly; and placing a reinforced concrete encasement collar around the casting frame to match the adjacent pavement grades.

B. Materials

1. PVC pipe adjustment ring (casting support) in accordance with MN/DOT 2503 or approved equal.
2. Waterstop shall be a **controlled expansion butyl rubber** water stop meeting the following:
 - a. Specific Gravity shall be 1.55 (+/- 5%) when tested in accordance with ASTM D-71.
 3. b. Volatile Matter shall not exceed 1% when tested in accordance with ASTM D-6.
 4. c. Minimum application temperature range between -10 degrees F to 125 degrees F.
 5. d. Minimum service temperature range between -30 degrees F to 180 degrees F.
6. Sealant shall be **elastomeric material** intended for the use depicted in the Plans and/or Standard Details.
7. Reinforcement for encasement collar shall **epoxy coated** in accordance with MN/DOT 3301.
8. Concrete for encasement collar shall be **Mix No. 3G52** in accordance with MN/DOT 2301 and MN/DOT 2461.

C. Construction Requirements

1. Temporary Cover Plate Installation

- a. The manhole shall be built with the top of the manhole cone 12" below proposed asphalt elevation.
- b. The area around the manhole must be backfilled with compacted aggregate base. This

aggregate must surround the entire manhole to the elevation of the top of the cone section or the bottom of the proposed roadway aggregate, whichever is lower.

- c. A steel plate shall be equipped with a device that will prevent excessive horizontal movement of the steel plate during the roadway construction process. The steel plate shall be centered on top of the cone, free of sealants and adhesives that would inhibit the ability to easily remove it from the manhole cone. The location of the center of the steel plate shall be preserved, through measurements and/or other accurate means of relocation, before paving.

2. Pavement Removal and Preparation

- a. Precautions must be taken to prevent debris from entering the manhole during the entire removal and reconstruction process. This will prevent the possibility of plugged sewers, interruptions in sewage flow and time required to remove the debris after construction.
- b. Cut and remove the asphalt pavement structure, around the manhole casting, with a rotating cutter device that creates a circle with a minimum diameter of 54" and centered about the casting. Dispose of the asphalt off-site.
- c. Remove the casting (manhole rim and cover) from the top of the manhole or manhole adjusting ring. Inspect the rim and cover for defects. If defects are present, replace with a new rim/cover as needed. If defects are not present, clean & retain for use in reconstruction.
- d. Remove all adjusting rings to the top of the manhole structure (concrete cone). Dispose of this material.
- e. Remove all aggregate around the manhole that has been exposed by the asphalt removal and dispose of this aggregate. The aggregate must be removed to a minimum of **2"** below the level of the top of the concrete cone.
- f. Clean and inspect the top surface of the concrete cone. The surface should be smooth and free of bumps and pits that may prevent a good water tight seal. Grind the surface as needed to remove protrusions. Utilize compressed air to blow dust and debris from the surface after grinding. Clean the surface with acetone. Utilize hydraulic cement, according to manufacturer's recommendations, to fill in depressions.
- g. A PVC pipe shall be used as an adjustment ring and temporary casting support. PVC adjustment ring must be cut to the exact profile and/or cross-slope of the road in all directions such that when the manhole rim and cover are resting on top of the support liner, the top of the casting shall be exactly **0.25 inch below flush** with the pavement surface in all directions. The adjustment ring support shall be marked in such a way, upon completion of the cutting process, that rotation does not occur, which could be detrimental to the end product. The top and/or bottom of the adjustment ring support shall also be marked to prevent the support from being installed up-side down, which could be detrimental to the end product.
- h. Apply a liberal amount of elastomeric sealant to the bottom of the adjustment ring support and set in place on top of the concrete cone while making sure it is properly aligned. This will create a water tight seal between the adjustment ring support and the concrete cone.

- i. Apply a liberal amount of elastomeric sealant to the top of the adjustment ring support. Set the manhole frame casting on the adjustment ring support while making sure it is properly aligned. This will create a water tight seal between the adjustment ring support and the bottom flange of the manhole frame casting.
 - j. Place the manhole lid on the rim casting to lessen the possibility of debris entering the manhole.
3. Concrete Encasement Collar Installation
- a. Place epoxy coated reinforcement around casting frame adequately supported to hold position during concrete placement.
 - b. Place concrete encasement collar in accordance with reference standards.
 - c. The surface of the concrete shall be finished from flush with the pavement to flush with the rim casting. The edge of the concrete shall be rounded (1/4" radius) where it meets the asphalt.
 - d. Fill the groove with a cold pour crack sealer. This will prevent water from entering the circular seam where the concrete collar meets the asphalt.
 - e. Apply a concrete curing and sealing compound to the surface of the concrete collar.
 - f. Protect concrete from loading & vibration until the concrete attains a compressive strength of 3,000 psi.
- D. Measurement and Payment
- Measurement will be made for each structure completed as specified. Payment will be made under Item 2506.602 (Concrete Encased Casting Collar) at the Contract bid price per each, which shall be compensation in full for all labor, equipment, and materials necessary to complete the work.

2506 CONNECT INTO EXISTING MANHOLE AND CATCH BASIN

MN/DOT 2506 is supplemented with the following:

This work shall consist of constructing connections into existing drainage structures in accordance with the applicable MN/DOT Standard Specifications and the following:

Connections to existing precast concrete sanitary manholes shall be made with core drill hole and water tight pipe sleeve. Connections to existing brick sanitary manholes shall be made with non-shrink grout to make water tight connection.

Measurement will be made by the number of connections constructed as specified.

Payment will be made under Item 2506.602 (Connect Into Existing MH OR CB) at the Contract bid price per each, which shall be compensation in full for all costs incidental thereto, including but not limited to, all materials and labor necessary to install proposed

pipe into an existing drainage structure. Any damage caused to the existing drainage structure shall be repaired at the Contractor's expense to the satisfaction of the Engineer.

2506 MANHOLE FRAME SEAL (INTERNAL/EXTERNAL)

Internal or External type manhole seals with stainless steel compression bands shall be used.

A. General

1. Work Required

An internal or external flexible rubber frame seal, and where allowed by the Engineer, an interlocking extension or extensions, meeting the requirements of this section, shall be used to seal the entire chimney section of sanitary manholes, air release manholes, clean out manholes and all other structures identified on the Contract Drawings or in the Special Provisions. The seal and extension or extensions shall extend from the frame down to the top of the cone.

2. System Description

Performance Requirements - The frame seal shall be capable of repeated vertical movement of the frame of not less than 2 inches and/or repeated horizontal movement of not less than ½ inch after installation and throughout its design life.

3. Quality Assurance

Acceptance Testing - Manhole frame seals shall be visually inspected after installation to insure that the seal is properly positioned, tight against the manhole and frame surfaces, that no voids or leakage points exist and that the bands are securely locked in place. Any seals failing this test shall be reworked as necessary and retested at no additional cost to the owner.

Any seals not passing this visual inspection may, at the Contractor's option, be tested for leakage using a method approved by the Engineer.

B. Products

An internal or external manhole frame seal, as shown on the Standard Details, with extensions where needed to cover the entire chimney area, shall be installed on all sanitary manholes air release manholes, clean out manholes and all other structures identified on the Contract Drawings or in the Special Provisions in accordance with the manufacturer's instructions.

Frame seals shall consist of a flexible rubber sleeve, interlocking extensions and stainless steel expansion bands as manufactured by Cretex Specialty Products or a pre-approved equal conforming to the following requirements.

The seal shall remain flexible throughout a 25 year design life, allowing repeated vertical movement of the frame of not less than 2 inches and/or repeated horizontal movement of not less than ½ inch. The sleeve portion of the seal shall be either double or triple pleated with a minimum unexpanded vertical height of either 8 inches or 10 inches respectively. The sleeve and extension shall have a minimum thickness of 3/16 inches and shall be made from a high quality rubber compound conforming to the applicable requirements of ASTM C-923, with a minimum 1500 psi tensile strength, a maximum 18% compression set and a hardness (durometer) of 48+5. The bands shall be integrally formed from 16 gauge stainless steel conforming to ASTM A-240, Type 304, with no welded attachments, shall have a minimum adjustment range of 2 diameter inches and a positive locking mechanism. Any screws, bolts or nuts used for this mechanism shall be 316 stainless steel conforming to ASTM F-593 and 594.

C. Equipment

The contractor shall have a manufacturer's recommended installation tool and all other equipment/tools necessary to install the frame seals.

D. Execution

1. Field Measurements

The Contractor shall measure the manhole to determine the information required on the manufacturer's "Sizing and Ordering" procedure. This information is needed to obtain the proper size of bands, the size and shape of the rubber sleeve and the need for and size of any extensions.

2. Surface Preparation for Seals

All sealing surfaces shall be reasonably smooth, clean, and free of any form offsets or excessive honeycomb. All loose and protruding mortar and brick that would interfere with the seal's performance shall be removed and the areas of the manhole frame, chimney and/or cone/corbel cleaned by wire brushing. All sealing surfaces shall be reasonably smooth and circular, clean and free of any loose material or excessive voids. Repair mortar, Non-Shrink Grout or Cement-Base Polymer Modified Patching and Repair Mortar shall be used to prepare a uniformly vertical 3" - 4" wide surface for the sleeve and extensions to seal against, if any adequate surface does not exist.

Detail surface preparation, including providing a vertical surface on a cone when none exists, shall be in accordance with the frame seal manufacturer's instructions.

The top portions of the cone shall have a minimum 2 inch high vertical surface. The preparation of this vertical surface when none exists shall be in accordance with the frame seal manufacturer's instructions.

3. Installation of Frame Seal

The frame seals and extensions shall be installed in accordance with the manufacturer's instructions.

3. Frame Seal Type

All manholes specified to have chimney seals located within the roadway shall have **internal** type seals. All manholes specified to have chimney seals located outside of the roadway shall have **external** style seals.

E. Measurement and Payment

All costs for furnishing and installing a frame seal and where allowed by the Engineer, an extension or extensions, shall be included in the unit price bid for manhole frame seals.

2506 MANHOLE VACUUM TESTING

A. Description

Conduct vacuum testing on manholes using vacuum testing equipment acceptable to Engineer.

Isolate manhole to be tested by plugging inlet and outlet pipes with inflatable stopper or other suitable test plugs. Securely brace plugs to avoid plugs being drawn into manhole. Plug lift holes with a non-shrink grout.

Place vacuum test equipment inside of top cone section and conduct vacuum test in accordance with manufacturer's recommendations. Operate vacuum pump until 10 in. of mercury is obtained.

Shut off vacuum pump and measure time for vacuum to drop from 10 to 9 inches of mercury. Manhole test is acceptable if the time exceeds the values in the table below:

Minimum Test Time for 48-inch Diameter Manhole			
Depth/Feet	Test Time/Seconds	Depth/Feet	Test Time/Seconds
8	20	20	50
10	25	22	55
12	30	24	59
14	35	26	64
16	40	28	69
18	45	30	74

If test fails, repair or seal manhole using non-shrink grout or other materials that are approved by Engineer. Retest until an acceptable test is obtained. Test may be conducted before or after backfilling.

B. Basis of Payment

All costs for furnishing and installing the equipment, maintenance, and labor necessary to perform the testing shall be included in the unit price for Manhole Vacuum Testing where a bid item is included. Where no bid item is included, manhole vacuum testing shall be incidental.

2511 RIPRAP

Riprap shall be furnished and placed in accordance with the provisions of MN/DOT 2511 and MN/DOT 3601.

All riprap shall have a minimum of **two fractured faces**.

2521 WALKS

Walks shall be constructed in accordance with the provisions of MN/DOT 2521 and the following:

Payment for 4 inch Concrete Walk shall include all costs of root cutting, excavation, disposing of excavated materials, grading, furnishing, placing and compacting the 4 inch Class 5 Aggregate base.

2531 CONCRETE CURBING

Concrete curb, concrete curb and gutter, medians, and driveway pavement, shall be constructed in accordance with the provisions of MN/DOT 2531 except as modified below:

1. Payment for driveway pavement shall include excavating, grading, and furnishing and placing 12 inches of Class 5 Aggregate Base.
2. All concrete gutters shall be stamped at the junction with all catch basins with a "NO DUMPING, LEADS TO LAKE" stamp meeting the requirements of City of Duluth Standard Detail STRM-7 listed in Appendix D.
3. Where the Engineer requires replacement of unacceptable concrete curb and gutter work, the Contractor shall drill and grout two No. 4 x 12 inch long reinforcement bars (epoxy coated) at each connection. Reinforcement bars shall be placed a minimum of 3 inches from face and back of gutter section. Where the contract does not provide a bid item for drill and grout reinforcement bars, all costs for drill and grout reinforcement bars for replacement concrete curb and gutter shall be incidental.

2531 CONCRETE CURB DESIGN V (ADA)

Revised 12-08-17

SP2018-191 modified: This work shall consist of constructing Concrete Curb Design V of varying heights up to 8 inches as detailed in the Plan and in accordance with the provisions of MN/DOT 2531, other Contract provisions, and the following:

1. CONSTRUCTION REQUIREMENTS

The Concrete Curb Design V shall be constructed as detailed in the Plan. Concrete Curb Design V may be constructed independent of or integral to the adjacent sidewalk. The bottom elevation of the Concrete Curb Design V shall match the bottom elevation of the adjacent sidewalk slab. When the Concrete Curb Design V is constructed independent of the sidewalk, the portion of the Concrete Curb Design V that will have new concrete walk placed against it shall be clean so as to maximize bonding between the walk and Concrete Curb Design V. The joint locations in the curb shall align with the joint locations in the adjacent concrete walk.

The locations requiring the use of Concrete Curb Design V will solely be determined in the Plans or in the field by the Engineer. Any Concrete Curb Design V that is constructed without pre approval of the Engineer will be considered unauthorized work for which no compensation will be made and may be removed at the Engineer's discretion. The height and length of the Concrete Curb Design V to be constructed shall be recommended by the Contractor and approved by the Engineer before the Concrete Curb Design V is constructed.

2. METHOD OF MEASUREMENT

Measurement will be by the linear foot of Concrete Curb Design V constructed measured at the face of curb. Curb height shall be measured from the top of the adjacent concrete walk to the top of the curb.

3. BASIS OF PAYMENT

Payment will be under Item 2531.603 (Concrete Curb Design V) at the Contract bid price per linear foot, which shall be compensation in full for all costs of performing the work as specified. All pedestrian concrete approach noses adjacent to the pedestrian ramp will be paid as 2 feet of Concrete Curb Design V. The pedestrian concrete approach nose adjacent the roadway curb and gutter shall be included in the payment for linear foot curb and gutter. Lengths of Concrete Curb Design V that never reach 3 inch height will be paid for as Concrete Walk.

2531 PEDESTRIAN CURB RAMP – TRUNCATED DOME SYSTEMS

Revised 12-08-17

SP2018-192: This work consists of furnishing and installing Truncated Dome Systems (detectable warning surfaces) at pedestrian curb ramps in compliance with the Public Rights-of-Way Accessibility Guidelines (PROWAG). Truncated domes shall provide a visual contrast to the concrete ramp of either dark on light or light on dark. This work shall be performed in accordance with the applicable MN/DOT Standard Specifications, these Special Provisions, details in the Plan, and the following:

1. CONSTRUCTION REQUIREMENTS

The Contractor shall select a truncated dome product from the approved products list at <http://www.dot.state.mn.us/products/detectablewarningsurfaces/index.html>. The truncated domes shall be placed in concrete and shall be pressed firmly into the concrete to the point that concrete fills the vent holes on the truncated dome plates. No cutting of truncated domes will be allowed unless approved by the Engineer. No more than one cut dome per pedestrian ramp is allowed and any cut sections used shall not be less than 2 SF of surface area. All cut edges shall be ground to a smooth surface leaving no sharp edges or burrs. If using coated colored truncated

domes they shall not be cut. Any swelling of the concrete that occurs around the truncated domes must be screeded off and the surrounding concrete shall be finished flush with the truncated dome plate edge. The finished installation of the truncated domes plates and the ramp surface plane shall have no surface deviations over 3/16 inches. To ensure that the truncated domes are well seated in concrete, the Contractor should provide a 3 inch minimum border around the edges of the truncated domes.

The Contractor will be allowed to interchange 9 foot 5 inch and 10 foot radial truncated domes when either is called for in the Plan. If the Contractor does make a substitution, the Contractor will be required to modify the curb line radius to match the truncated domes and meet the detectable edge requirements shown on Standard Plan Sheet No. 5-297.250 (Sheet 4 of 6). The Contractor will be allowed to adjust plan locations of zero inch height curb up to 6 inches laterally to make field fit adjustments for radial truncated domes placement.

2. METHOD OF MEASUREMENT

Square or rectangular truncated dome area will be measured by the square foot. Radial Truncated domes will be measured along the long cord and multiplied by 2 feet to compute S.F.

3. BASIS OF PAYMENT

Payment will be under Item 2531.618 (Truncated Domes) at the Contract bid price per square foot, which shall be compensation in full for furnishing and installation of truncated domes. If additional radial domes are required and not called for in the plans they will be paid for at 4 square feet per each additional plate.

2540 MAIL BOX SUPPORT

REVISED 12-08-17

SP2018-200: This work shall consist of removing existing mailbox supports and furnishing and installing new Mail Box Supports in accordance with the applicable MN/DOT Standard Specifications, Standard Plate 9350A, and the following:

- A. It is the Contractor's responsibility to coordinate with property owners and the local postal authority as to establishing and installing permanent mailbox location(s).

The inplace mail box, or a new mail box if furnished by the owner, attached distribution box and/or sign, if present, shall be salvaged and installed on the new support. The inplace support shall be removed with as little damage as possible and offered to the property owner. If the owner does not want the support the Contractor shall dispose of it off the Right-of-Way in accordance with MN/DOT 2104.3D3. All depressions resulting from removal process shall be filled.

All removal and replacement operations shall be done in such a manner so as to cause no interruption of mail delivery if at all possible. In no case shall the owner or resident be without a mailbox installation for more than 24 hours.

- B. Measurement will be made by the number of Mail Box Supports furnished and installed as specified in the Plan.

- C. Payment will be made under Item 2540.602 (Mail Box Support) at the Contract bid price per each, which shall include but not be limited to all items as specified above, except those that the Contract specifically designates as having been included for payment under separate items.

2540 RELOCATE MAIL BOX SUPPORT

REVISED 12-08-17

SP2018-201: This work shall consist of relocating existing mailbox supports in accordance with the applicable MN/DOT Standard Specifications, Standard Plate 9350A, and the following:

- A. It is the Contractor's responsibility to coordinate with the local postal authority as to where the temporary location(s) shall be and to notify the postal patrons of the locations.

The in-place mail box, or a new mail box if furnished by the owner, attached distribution box and/or sign, if present, shall be salvaged and installed at the new location as staked in the field by the Contractor. All depressions resulting from the relocation process shall be filled.

All relocation operations shall be done in such a manner so as to cause no interruption of mail delivery if at all possible. In no case shall the owner or resident be without a mailbox installation for more than 24 hours.

- B. Measurement will be made by the number of Mail Box Supports relocated, as specified in the Plan.
- C. Payment will be made under Item 2540.602 (Relocate Mail Box Support) at the Contract bid price per each, which shall include but not be limited to all items as specified above, except those that the Contract specifically designates as having been included for payment under separate items.

2540 CONSTRUCT SURVEY MONUMENT

The work shall consist of providing survey monument to re-establish monuments displaced by the construction. The survey monument will generally consist of a steel reinforcement bar set in concrete to a precise location. The top elevation of the monument will be set below the finished surface and covered with a casting assembly. Refer to Standard Detail Drawings SUR-1 and SUR-2 listed in Appendix D.

- A. Materials

- 1) The City of Duluth will supply the monument casting cover and frame.

- 2) The Contractor shall supply all other materials necessary to provide the monument as shown in the details including the PVC pipe sleeve, backfill, epoxy reinforcement bar, and concrete.

B. Construction

- 1) The Engineer will set the 1" rebar.
- 2) The contractor shall set the PVC tube and place the concrete around the rebar as detailed.
- 3) The contractor shall notify the Engineer 48 hours prior to setting the monument.
- 4) Where the monument is located within the roadway, the Contractor shall additionally provide a concrete encasement casting collar as detailed. The concrete shall be protected from traffic for a minimum of 7 days to allow for curing.

C. Measurement and Payment

Survey monuments will be measured by the number of completed monuments. Payment will be made under Item 2540.602 (Survey Monument) or Item 2540.602 (Survey Monument in Roadway) at the contract unit price per each, which shall be compensation in full for all materials, labor, and equipment necessary to provide the monument.

2540 PARKING METER POST/BRACKET INSTALLATION

The size of all material and posts shall be approved by the City of Duluth. All parking meter posts shall be inserted into soil at a minimum depth of 36 inches and surrounded by six inches of concrete. All parking meters installed in sidewalks or other areas of concrete surfaces shall use an installation bracket and comply with Standard Detail T-1. All traffic meter upright posts, when used, shall have a minimum height of 4 feet above surface level.

2540 BRICK PAVEMENT RESTORATION

This work shall consist of constructing or reconstructing brick paver street pavement and brick paver sidewalk shall be in accordance with the relevant MN/DOT standards, and as modified in these standard specifications.

A MATERIALS

Materials for brick paver street pavement and brick paver sidewalk shall generally match the size, color, and texture of existing brick pavers; and shall meet the relevant physical properties necessary to perform adequately for the intended use. Submit product samples and certificate of compliance from manufacturer for review by Engineer.

1. Brick pavers shall be dense, with extruded wire cut face and shall comply with ASTM Designation C902-79a as modified below:
 - Class SX: Compressive strength, flatwise, gross area (min.) 15,000 P.S.I.
 - Cold water absorption (max.) 6%
 - Modulus of Rupture (per ASTM C67-80a) 1,500 P.S.I.
 - Type I Traffic, Abrasion Index Maximum 0.04
(50 cycle freeze thaw, Submit manufacturer test results)
 - Unit Size: 4 inch (W) x 8 inch (L) x 2-1/4 inch (D)
 - Unit Size over Vault: 4 inch (W) x 8 inch (L) x 1-5/8 inch (D)
 - Unit Size Allowed Variation (+/-): 3/32 inch for Width

1/16 inch for Depth

- Skid Resistance (ASTM-E-303-74 British Pendulum Method (min.) 70
2. Color and texture of brick pavers shall be similar to:
 - a) Street/Sidewalk Paver
 - Endicott - #46 Medium Ironspot & Dark Ironspot
 - TK Yankee Hill – Modified Tan Flashed and Dark Flashed Brown
 - b) Centerline/Driving Lane Paver
 - Endicott – Coppertone
 - TK Yankee Hill – Mojave
 3. Asphalt setting bed materials shall meet gradation “A” of Table 3139-2 Aggregate Gradation Broad Band of MN/DOT 3139 or approved equal. Asphalt binder for asphalt setting bed material shall be Type B (PG 58S-28) or approved equal. Submit design mix for review by Engineer.
 4. Neoprene-modified asphalt adhesive (or approved equal) shall meet:
 - Mastic (asphalt adhesive):
 - | | |
|---------------|-------------------------------|
| Solids (base) | 75 +1% |
| Lbs./Gallon | 8 – 8.5 lbs. |
| Solvent | Varsol (>100 degree F. flash) |
 - Base (2% neoprene, 10% fibers, 88% asphalt):

Melting Point (ASTM D-36)	200 degree F. minimum
Penetration (.1 m.m.)	23 - 27
Ductility (ASTM D-133-44)	125 cm minimum
 5. Joint filler shall be Portland Cement, or approved equal, with pre-mixed color conforming to ASTM C-150, consisting of clean natural sand, free of organic material, 100 percent passing a No. 8 sieve, with a maximum of 10 percent passing a No. 200 sieve. Mixture shall be: one part Portland Cement to three parts sand. Submit color sample for review by Engineer.
 6. Expansion joint (board) material shall meet MN/DOT 3702 or approved equal.
 7. Expansion joint sealant materials shall meet the following or approved equal.
 - A) Horizontal Joints. Sealant shall be **two-part**, self-leveling, non-tooling, polyurethane. Shore “A” hardness of not less than 38. Tack free four hours after application with non-asbestos filler to prevent running or sagging on 5 percent slope. Color to match existing as closely as reasonable. Submit color sample for review by Engineer.
 - (1) For joints with a **slope less than or equal to 5 percent**, sealant products shall be: MasterSeal SL2 by Master Builders - BASF; Urexpam NR200 by Pecora Corp; Sikaflex 2cSL by Sika Corp.; or approved equal.

(2) For joints with a **slope greater than 5 percent**, sealant products shall be: MasterSeal SL2 by Master Builders - BASF; DynaTrol II-SG by Pecora Corp; Sikaflex 1cSL by Sika Corp.; or approved equal.

B) Vertical Joints. Sealant shall be **one-part**, non-prime, urethane. Sealant products shall be: MasterSeal NP1 by Master Builders - BASF; DynaTrol II by Pecora Corp; Sikaflex 1a by Sika Corp.; or approved equal.

8. Brick paver cleaner shall meeting the following: Sure Klean "Protec Tile" by Pro-So-Co, Inc.; Super Grout Release by Klein Co.; Dry-Seal by Concrete Service Materials Co.; or approved equal. Emulsion is a temporary protective liquid coating formulated to coat brick pavers prior to grouting (joint filling). Paver detergent shall be final clean-up material. Detergent shall be a blend of surface acting acids, chelating and wetting systems. Its form shall be water-clear liquid with specific gravity of 1.13 and a pH of 0.5 (at 1:6 dilution); or approved equal.
9. Concrete shall meet MN/DOT 2301 and MN/DOT 2461.
 - Concrete design mix 3F52 (sidewalk) and 3R52 (concrete base).
 - Drill and grout 1" dia. dowel bars or No. 8 reinforcement "tie" bars (24" length) at 16" O.C. into adjacent existing concrete base.

B CONSTRUCTION

The work shall generally be completed in accordance with relevant sections of MN/DOT for excavation, aggregate base, concrete base, concrete pavement, and concrete walk. In addition, the brick installation work shall meet the following:

1. Placing Asphalt Setting Bed & Adhesive

To install the setting bed over the concrete base surface, place $\frac{3}{4}$ inch deep control bars directly over the base. If the grades must be adjusted, set wood chocks under depth control bars to proper grade. Set two bars parallel to each other approximately 11 feet apart to serve as guides for striking board (12 ft. long x 2 in. x 6 in.). The depth control bars shall be set carefully to bring the pavers, when laid, to proper grade.

Place asphalt setting bed materials between the parallel depth control bars. Pull this bed with the striking board over these bars several times. After each passage, low porous spots shall be filled with fresh asphalt setting bed materials to produce smooth, firm, and even setting bed. As soon as this initial panel is completed, advance the first bar to the next position in readiness for striking the next panel. Carefully fill up any depressions that remain after removing the depth control bars and wood chocks.

The setting bed shall be rolled with a power roller to a nominal depth of $\frac{3}{4}$ inch while still hot. The thickness shall be adjusted so that when the bricks are placed, the top surface of the pavers will be at the required finished grade.

A coating of two percent neoprene-modified asphalt adhesive shall be applied by mopping, squeegeeing, or troweling over the top surface of the asphalt setting bed so as to provide a bond under the pavers. If it is troweled, the trowel shall be serrated to provide 1/16 inch adhesive height. Adhesive shall be installed in accordance with manufacturer's recommendations.

2. Brick Paver Installation

After brick adhesive is applied, carefully install pavers in straight courses with hand tight joints and uniform top surface. The pattern shall be herringbone as shown in the Plans or as directed by the Engineer. The face of the brick shall be the street surface. Generally, hand tight joints shall be approximately 1/8 inch. However, the following tolerances shall pertain as well:

- Maximum joint spacing for up to 10 consecutive parallel joints shall not exceed ¼ inch width per joint. Joints exceeding ¼ inch width will not be acceptable, and shall be corrected immediately.
- Vertical displacement of any one or more bricks shall not exceed 1/8 inch either above or below and adjacent surface. Surface variations exceeding 1/8 inch will not be acceptable, and shall be corrected immediately.

If the finished paver surface has a differential height exceeding tolerances described above, remove pavers, fill, compact, and level setting bed, apply adhesive and re-install pavers as specified.

Allowable tolerance for overall surface shall be ¼ inch per 10 feet from the finished grade. Allowable tolerance between concrete base and brick pavers is ¼ in surface height.

3. Brick Layout

Install 1-5/8 inch thick paver over vault sidewalk to remain. Where non-structural topping sidewalk is removed, install 2-1/4 inch thick pavers. Install 2-1/4 inch thick pavers elsewhere. Install centerline/driving lane pavers in soldier course pattern, double row at centerline, single row at driving lane as shown in the Plans, or directed by Engineer.

To obtain smooth surface, cover pavers with ½ inch thick plywood, or similar sheathing, and roll with roller to level paver surface to comply with specified tolerance.

Make necessary brick paver cuts with a saw to create clean-cut edges. Units with chipped surfaces or irregular cuts will not be accepted.

4. Paver Joint

Apply protective emulsion in accordance manufacturer's recommendations. Avoid excessive application of material to avoid brick joints being coated. Allow approximately 20 minutes drying or manufacturer's recommendation.

Sweep joint filler mixture of dry sand and colored cement into joints until completely filled. Remove excess materials and broom sweep surface.

Fog the entire area of sand filled joints with a light mist of water spray. Allow the cement in joints to take initial set before heavy rinse.

5. Cleaning and Repairing

Clean, repair, adjust, or replace brick pavers when directed by the Engineer. This may include materials which have been soiled, discolored, or damaged by work covered under these provisions.

Clean paver surface with cleaning detergent within 48 hours of joint filling, according to manufacturer's recommendations. Spray or brush onto surface, allow detergent to sit 3-5 minutes. Scour with stiff bristle brushing action and completely rinse surface of cement residue.

C MEASUREMENT AND PAYMENT

Brick paver street pavement and brick paver sidewalk will be measure by top surface area in square feet. Payment for brick paver work will be made under Item 2540.618 (Brick Paver Street Pavement) or 2540.618 (Brick Paver Sidewalk) at the Contract unit price per square foot, which shall be compensation in full for all labor, equipment, and materials necessary to complete the work including, but not limited to; excavation, foundation preparation, aggregate base, concrete base, concrete sidewalk, concrete curb and gutter, asphalt setting bed, asphalt adhesive, brick, joint filling, joint sealing, and cleaning completed and accepted.

2545 ADJUST HANDHOLE FRAME AND COVER

This work consists of adjusting existing hand holes to match the surrounding sidewalk. The city of Duluth will provide new frames and covers for any square covers that need adjusting at no cost to the contractor. Existing round covers shall be salvaged and reinstalled. This work shall be in accordance with the applicable MN/DOT Standard Specifications, as detailed in the plans, and the following:

This work shall consist of:

- 1) Salvaging square frames and covers and arrange for delivery of salvaged items and the pick-up of new round frames and covers at 1530 W. Michigan Street with Earl Stewart at 730-4421. Contact Earl 3 working days in advance of delivery or pick-up.
- 2) Remove concrete from walls of hand hole so that the frame and cover will stand clear of the hand hole and be flush with the concrete walk;
- 3) Replace the salvaged frame and cover, making sure it is supported by at least 2 inches above the hand hole frame by material that can be removed after the sidewalk concrete is set. If necessary, place new concrete 4" thick 8" wide adjacent to the frame.

Measurement will be made by each hand hole adjusted under Item 2545.602, Adjust Hand hole Frame and Cover, as specified, and shall include the delivery of salvaged items, and additional sidewalk.

2563 TEMPORARY TRAFFIC MANAGEMENT

New Write-Up 12-05-18
SP2018-20.1 modified:

1. DESCRIPTION

Furnish, install, maintain, and remove all traffic control devices required to provide safe movement of traffic and pedestrians through the Project at all times from commencement of the Work until Project Acceptance. Do not close roadways or pedestrian facilities, except as authorized. The Engineer may modify the requirements for traffic control as deemed necessary.

All temporary traffic management must conform to and be installed in accordance with the current version of the following:

- the "Minnesota Manual on Uniform Traffic Control Devices" (MN MUTCD);
- the "Minnesota Temporary Traffic Control Field Manual" (Field Manual);
- the "Speed Limits in Work Zones Guidelines";
- the "Minnesota Flagging Handbook";
- the "MN/DOT Standard Signs and Markings Manual";
- the Plan;
- all applicable standard specifications and special provisions.

Manuals listed above may be found at: <http://www.dot.state.mn.us/trafficeng/publ/index.html>

2. MATERIALS

A Temporary Signs and Devices

Reflectorize all signs, paddles, and other traffic control devices including those used for daytime operations. Fabricate temporary rigid signs and devices with retroreflective sheeting material of the appropriate color listed on the Approved/Qualified Products List (APL/QPL) for either "Sheeting for Rigid Temporary Work Zone Signs, Delineators, and Markers (Type IX and XI)" or "Sheeting for Rigid Permanent Signs, Delineators, and Markers (Type IX and XI)". The sheeting materials APL/QPL is located at the following link:

<http://www.dot.state.mn.us/products/signing/sheeting.html>.

Inplace signs that still apply during temporary operations need no change in sign sheeting.

B Vehicle Conspicuity Tape

The Approved Products List for "Conspicuity Vehicle Sheeting (Type VII)" is found at:

<http://www.dot.state.mn.us/products/signing/sheeting.html>

C Truck/Trailer Mounted Attenuators

The Approved Products List for "Mobile Crash Attenuators" is found at:

<http://www.dot.state.mn.us/products/temporarytrafficcontrol/mobilecrashattenuators.html>

D Drum Sheeting

On Projects requiring drums per MN/DOT Standard Plate No. 8000J (Channelizers – Type B), provide all drums with six inch fluorescent orange and white sheeting material with no gap between sheeting layers.

E Crashworthy Signs, Traffic Control Devices, and Ballast

Signs and traffic control devices must meet the crash testing requirements of NCHRP 350 as specified in the MN MUTCD or the Manual for Assessing Safety Hardware (MASH). The Department may require a letter of compliance stating that all signs and traffic control devices comply with NCHRP 350 or MASH requirements. The Letter of Compliance must include drawings of the different signs and devices along with a copy of their FHWA eligibility letter.

The approved ballast system for signs and devices mounted on temporary portable supports is sandbags, unless it is designed, crash tested, and approved for the specific device. Add a deicer during freezing conditions to prevent the sand from freezing. Place sandbags at the base of the sign or traffic control device. Do not use any ballast that causes a sign or traffic control device to become hazardous to motorists or workers.

F Temporary Pavement Markings

Any temporary pavement markings installed must follow the requirements of MN/DOT 2582, "Pavement Markings" and utilize Wet Reflective (WR) materials.

3. CONSTRUCTION REQUIREMENTS

A Traffic Control Plan, Maintenance, and Inspection

A.1 Submit a proposed traffic control plan to the Engineer for acceptance if traffic control is not present in the Plan, or if the Contractor modifies the traffic control plan. Submit the proposed traffic control plan at least seven days before implementation. If Field Manual layouts are used, specify layout number(s) but do not submit the layouts from the Field Manual. Do not implement the proposed traffic control modification until accepted by the Engineer.

A.2 Immediately repair or replace all traffic control devices that become damaged, moved or destroyed, and all ballasts that are damaged, destroyed, or otherwise fail to stabilize the device.

A.3 Meet the traffic control device quality standards as required in the Field Manual. Immediately replace unacceptable traffic control devices. Signs that are dirty and result in a noticeable loss of reflectivity at night are considered unacceptable and must be cleaned or replaced. Respond promptly to any call from the Engineer concerning the notification of unacceptable traffic control devices.

A.4 Provide the names, addresses, and phone numbers of at least three individuals responsible for placing and maintaining traffic control devices to the Engineer at the Pre-construction Conference. These individuals will be "on call" 24 hours per day, seven days per week during the times any temporary traffic control devices are in place.

A.5 Inspect all traffic control devices on a daily basis, including one nighttime inspection per week. Verify that the devices are placed in accordance with the Traffic Control Plan, these Special Provisions, and the MN MUTCD. Immediately correct discrepancies between the actual placement and the required placement. Respond immediately to any call from the Engineer concerning any request for improving or correcting traffic control devices.

A.6 Make a daily log of required inspections. This log must indicate the date and time any changes in the stages, phases, or portions go into effect. The log must identify the location and verify that the devices are placed as directed or corrected in accordance with the Plan. The person making the inspection must sign the log and include the date and time of the entry. Provide copies of the inspection logs on a weekly basis and at the request of the Engineer.

B Traffic Control Signs and Devices

B.1 Roll-up signs are not allowed unless authorized by the Engineer.

B.2 Cover, modify, or remove all signs that are not consistent with traffic operations. Cover the entire sign or that part of the legend that is inappropriate. Sign covers must conform to the Typical Temporary Sign Covering Details Sheet found in the Plan or at the following link:

<http://www.dot.state.mn.us/trafficeng/workzone/wz-templates/pdf/layout%2020A.pdf>

B.3 Maintain street identification signage at all times. Signs may be installed on temporary supports if the permanent sign structures are affected by operations. This is necessary to maintain the 911 emergency system.

B.4 Post mount all signs that will remain in the same location for more than 30 consecutive days as shown on the Typical Temporary Sign Framing and Installation Detail Sheet. This does not include portable signs which are set up and taken down at the beginning and end of each work shift. The detail sheet may be found in the plan or at the following link:

<http://www.dot.state.mn.us/trafficeng/workzone/wz-templates/pdf/layout%2020.pdf>

When the proper location of a sign is on pavement, do not core through the surface. If there is a conflict with underground utilities, attempt to move the sign while maintaining its visibility to traffic. If it is not possible to drive posts into the ground, mount signs on portable supports as approved by the Engineer.

When signs are removed, the sign posts and stub posts must also be removed from the right of way. Posts left in place for future use or removal at a later date must be properly delineated with tubular markers, flags, or other delineation as approved by the Engineer at no additional cost.

B.5 Section intentionally left blank.

B.6 Section intentionally left blank.

B.7 All in place signs and delineators that interfere with the Contractor's normal operation may be temporarily relocated by the Contractor at the direction of the Engineer. Store salvaged signs in such a manner as to protect the sign from scratching, fading, or other harmful effects until the signs are reinstalled. After completing work at each sign location, or at the direction of the Engineer, replace the signs as near to their original locations as possible or to a location designated by the Engineer. Reinstall sign structures according to the Type C & D Sign Structural Details Sheet located at the following link:

<http://www.dot.state.mn.us/trafficeng/signing/plansheets/groundmounted.pdf>

Signs and structures damaged by the Contractor shall be replaced at the Contractor's expense.

C Traffic Safety

C.1 Do not suspend material, equipment, tools or personnel over lanes or pedestrian facilities open to traffic.

C.2 Protect traffic and pedestrians from excavations, drop-offs, falling objects, splatter or other potential construction hazards.

C.3 Do not store materials or equipment in the clear zone unless approved by the Engineer. If materials or equipment must be stored within the clear zone, provide Type B channelizers, barricades or barriers, and place near the object to warn and protect traffic.

C.4 Do not park vehicles or construction equipment in the clear zone or any location that obstructs traffic control devices. Workers are not allowed to park their private vehicles within the Project limits unless approved by the Engineer.

C.5 Do not load or unload material or equipment on the shoulders of any roadway without a full shoulder closure using signs and channelizing devices shown on Layout 8 in the Field Manual.

D High Visibility Apparel

During night work or low light conditions, all workers must wear high visibility Class E long pants and retro-reflective headgear in addition to the ANSI Class 2 or 3 vest, shirt, or jacket.

All high visibility apparel must be worn in the manner for which it was designed. All apparel worn on the torso must be closed in the front to provide 360 degree visibility. A worker's high-visibility apparel must be removed from service and replaced if it becomes faded, worn, torn, dirty, or defaced, reducing the conspicuity of the apparel.

E Night Work

Night work is NOT permitted without prior approval of the Engineer.

F Vehicle Warning Light Specification

All vehicles and equipment operating in the road right of way, must have operable warning lights that meet the appropriate SAE specification. The SAE specification requirements are as follows:

- Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles- SAE Specification J845.
- Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles - SAE Specification J595.

Details on SAE Specification can be found at:

<http://www.dot.state.mn.us/const/wzs/lighting.html>

G Lane Closure Requirements

G.1 Unless otherwise stated in the project Special Provisions, temporary lane closures or other traffic restrictions by the Contractor, during work hours and consistent with the time restrictions, will be permitted only during those hours and at those locations approved by the Engineer. Request temporary lane closures at least 72 hours prior to such closures.

G.2 The Engineer may lengthen, shorten, or otherwise modify the following periods of restrictions as warranted by actual traffic conditions.

G.2.1 Work that will restrict or interfere with traffic will not be permitted between the hours of 6:30 A.M. and 8:30 A.M. and between the hours of 3:30 P.M. and 5:30 P.M.

G.2.2 Section intentionally left blank.

G.3 Work that will restrict or interfere with traffic shall not be performed between 12:00 noon on the day preceding and 9:00 A.M. on the day following any consecutive combination of a Saturday, Sunday and legal holiday.

G.4 If the Contractor fails to adhere to the established time schedules, the Department may assess an hourly charge of \$500.00 per hour for each hour or portion of an hour that the Engineer determines that the Contractor has not complied.

G.5 Place traffic control devices in any temporary lane closure that is adjacent to traffic and extends beyond 1000 feet as shown on Layout 61 of the Field Manual. When the lane closure is in place three days or longer, use only Type III barricades.

G.6 Use Drum Channelizers in all lane closure tapers and in any shifts in traffic alignment.

G.7 No center lane closures will be permitted.

G.8 Maintain a minimum of two miles between temporary lane closures.

G.9 Temporary lane closures will not be permitted during inclement weather, nor any other time when, in the opinion of the Engineer, the lane closure will be a greater than normal hazard to traffic.

G.10 Section intentionally left blank.

H Truck/Trailer Mounted Attenuators (TMAs) For Mobile/Short Duration Operations

Truck/Trailer Mounted Attenuators (TMA) must be used on all shadow and protection vehicles operating totally or partially in a traffic lane if any temporary traffic control zone is defined as “Mobile/Short Duration” by the Field Manual. All references to “should” in the Field Manual in regards to TMA use for Mobile/Short Duration layouts are hereby changed to “shall”. This requirement applies to all operations utilizing Field Manual layouts 9, 12, 13, 36, 41, 49, 50, 51, 54, 55, 63, 76, 77, 78, and 79. Providing TMAs for “Mobile/Short Duration” work zones is incidental.

I Flagging Operations

I.1 Flaggers must attend a training session taught by a MN/DOT-Qualified Flagger Trainer. The trainer must have completed a “MN/DOT Flagger Train the Trainer Session” within the last five years and be on file as a qualified Trainer with MN/DOT. Provide the Flagger Trainer’s name and qualification number at the pre-construction meeting. Provide all flaggers with the MN/DOT Flagging Handbook. Flaggers must be in possession of the handbook while flagging on the Project. Furnish the signed “Checklist for Flagger Training” or “Flagger Qualification Card” to the Engineer any time a new flagger reports to work on the Project. The “Checklist for Flagger Training” and other forms and information is found at:

<http://www.dot.state.mn.us/const/wzs/flagger.html>

I.2 All signs associated with the flagging operation must be removed or covered when flagging operations are not present.

I.3 Coordinate the flagging operations in a manner that causes minimum delay to the traveling public. The maximum delay time is **10 minutes**. If the operation exceeds the maximum delay time, the operation must be discontinued until a new traffic control plan is developed which meets the maximum delay requirement.

I.4 Section intentionally left blank.

I.5 Furnish Flaggers in sufficient quantity to control each approach to the work area including intersecting crossroads that are open to traffic.

J Milling, Sealcoating, and Paving Operations

J.1 Traffic will be allowed on the milled surface.

J.2 Unless otherwise state in the project Special Provisions, when traffic is allowed to drive on the milled and newly paved surfaces, install interim striping and provide appropriate

warning signs such as "GROOVED PAVEMENT" and "BUMP" with "Advisory Speed" plaques as shown on Layouts 35 and 66 of the Field Manual.

J.3 Taper and/or chamfer any drop-off where traffic will cross from or to the in-place surface, or from or to the milled surface, so as to provide for the safe passage of traffic.

J.4 Schedule construction operations to minimize traffic exposure to uneven lanes, milled edges, and edge drop-offs. If these conditions cannot be avoided, provide and maintain the appropriate traffic control in accordance with the "DROP OFF GUIDELINES" in the Field Manual.

J.5 Do not mill any notches for surfacing tapers until immediately prior to paving. The Engineer may allow notches if temporary bituminous is installed and maintained to provide for the safe passage of traffic until the surfacing is completed. Constructing and milling tapers and/or chamfers is incidental.

J.6 Maintain traffic with a minimum of delay during milling and paving operations at intersections controlled by signals or by all-way stop signs. Provide off-duty police officers to direct and control traffic at intersections with fully operating traffic control signal systems.

J.7 Intersecting streets, other than intersections controlled by signals or all-way stop signs, may be closed during milling and paving operations in the intersection if there are adequate alternate routes for the intersecting street traffic. Do not close adjacent intersecting streets to traffic concurrently. Notify the local road authorities of its schedule to close intersecting streets 72 hours in advance of the closure. Refer to section 1404 of these provisions for a list of local stakeholders.

J.8 When traffic is allowed to drive on the sealed surface, provide and install "LOOSE GRAVEL" and "FRESH OIL" signs with "Advisory Speed" plaques as shown on Layouts 35 and 66 of the Field Manual.

K Signal Systems

K.1 Do not interfere with the operation of any traffic signal system, except as required by the Contract. Notify the Engineer at least 72 hours prior to beginning any work that will interfere with any traffic signal system or its detection system.

K.2 The in-place signal system(s) must remain in operation until the new signal system(s) become operational.

K.3 During the period when the existing signal system is not operational and the new signal system is operational, provide, erect, and maintain "Stop Ahead" and "Stop" signs. The Engineer will determine the quantity and size of the temporary signs as well as their placement in the field.

L Maintenance and Staging of Traffic Control

- L.1 Section intentionally left blank.
- L.2 Pedestrian traffic must be maintained and guided through the Project at all times.
- L.3 Section intentionally left blank.
- L.4 Maintain a minimum lane width of 11 feet on all roadways. Traffic must not be allowed or forced onto the shoulders without prior approval of the Engineer.
- L.5 Parking may be banned within the construction limits of the project. Notify the City of Duluth Engineering Division, phone number 281-730-5200 at least 48 hours prior to posting any parking ban within the City. Provide and install the necessary signing 24 hours prior to the parking ban. Remove signs as soon as the work in the area has been completed.
- L.6 Submit plans for access to and from the project site for approval by the Engineer at least one week before implementation.

4. METHOD OF MEASUREMENT

All traffic control required to complete the Project as shown in the Plans and as specified in the project Special Provisions will be measured as a lump sum payment under Item 2563.601 (Traffic Control). Payment includes all costs associated with furnishing, installing, maintaining, relocating and subsequently removing traffic control devices (including flaggers) as required. No additional measurement for payment will be made for individual activities and devices that constitute Traffic Control, except for other traffic control Bid items specifically listed in the Statement of Estimated Quantities.

Traffic Control layouts and devices not shown in the plan or stated in these Special Provisions, that are necessary to facilitate traffic switches or for transitioning traffic from one stage to another, are included in the lump sum traffic control item. If the Contractor requests a change in traffic control and these changes are implemented, there will be no increase or decrease in the lump sum payment for traffic control. If the Engineer orders a change in traffic control because of a Plan error, omission, changed condition or change of project scope, payment for such changes will be made as Extra Work.

If the Contractor fails to properly provide, install, maintain, or remove any of the required traffic control devices, the Department may correct the deficiency and to deduct the costs from any moneys due or becoming due to the Contractor in accordance with MN/DOT 1512, "Unacceptable and Unauthorized Work".

5. BASIS OF PAYMENT

Partial payments for lump sum Item 2563.601 (Traffic Control) will be made as follows:

Table 2563-1	
Traffic Control Partial Payments	
Percent of Original Contract Completed	Pay this Percentage of Traffic Control
5	50
10	75
50	95
All Work Completed And All Traffic Control Removed	100

2563 ALTERNATE PEDESTRIAN ROUTE

Revised 03-09-18

SP2018-230 modified: MN/DOT 2563 is supplemented with the following:

- A. Maintain and guide pedestrian traffic through the Project at all times using continuous Alternate Pedestrian Routes (APRs) per standards set forth in the MN MUTCD Chapter 6D. Provide each APR to the same level of accessibility of each existing access and walkway prior to construction. Utilize accessible device standards as shown in the plan or in Figure 6K-5 in the Field Manual if a plan is not provided. Utilize bypass and detour standards as shown in the plan or in Layouts 88 and 89 in the Field Manual if a plan is not provided.

Provide and place accessible pedestrian signals (APS), temporary curb ramps, pedestrian barricades, pedestrian channelizers, detectable edges, temporary walkway surfaces and other accessible design features as necessary.

As needed, provide continuous temporary walkway surfaces that are smooth, stable and slip resistant in relevant weather conditions. Temporary walkway surfaces will allow the normal usage of wheelchairs, walkers, strollers, and other mobility devices. Concrete, bituminous, steel, rubber, wood (3/4 inch or thicker), and plastic are acceptable surface materials for the temporary walkway surface. Gravel, millings, or other uneven surfaces are not acceptable surface materials. Temporary walkway surface devices shall utilize dimensions from 6F.74.1 in the MN MUTCD. The temporary walkway surface shall be supported by a solid base.

Any portable sign or barricade placed in or adjacent to a pedestrian walkway shall have a detectable edge to guide pedestrians with visual disabilities around the sign or barricade.

- B. Minimize disruption to pedestrians to the maximum extent feasible by providing APRs in the following order of preference:

1. Provide the APR on the same side of the street as the disrupted route utilizing bypasses.
2. Where it is not feasible to provide a same side APR, provide an APR on the other side of the street.
3. Where it is not feasible to provide an APR on the other side of the street, provide an APR detour with trailblazing signs.

If existing parking spots are desired to be used for an APR route within the project limits, contact the City of Duluth Engineering Front Desk at 218-730-5200 for approval and parking banning notification procedures.

- C. Schedule and coordinate the replacement of pedestrian access to accommodate the needs of businesses and residences 2 days prior to the replacement. Leave the existing sidewalks in-place until such time that it is required to remove them to accommodate new construction. Pedestrian access may be provided to businesses and homes through the use of any public access from adjacent parking lots and side streets. Provide front door access to buildings without alternate public entrances.
- D. Protect the pedestrian route with pedestrian barricades or pedestrian channelizing devices if it is adjacent to construction, excavation drop-offs, traffic, or other hazards. Protect the pedestrian route with portable barrier if it is on the shoulder, in a parking lane, or in a closed lane adjacent to traffic on a multilane road or if the speed limit is greater than 40 mph. When both sides of a pedestrian route require channelizing devices, use similar types, unless portable barrier is used to protect pedestrians from traffic.
- E. No pedestrian curb ramp or blended transition work shall occur concurrently at adjacent intersections.
- F. The Contractor is advised that the corridor may have Transit service. Re-locations of stops can only be made with the approval of both the Engineer and the Transit Authority.
- G. Notify the Engineer in writing at least 24 hours prior to the start of any construction operation that will necessitate a change in pedestrian access.
- H. Furnish the name, address, email, and phone number of at least one individual responsible for the maintenance of the APR. This individual shall be "on call" 24 hours a day, seven days per week during the times any devices, furnished and installed by the Contractor, are in place. Submit the required information to the Engineer at the pre-construction meeting.
- I. Answer calls immediately and begin corrective measures needed within one hour. If the Contractor is negligent in correcting the deficiency within one hour of notification the Contractor shall be subject to a monetary deduction at the rate of \$100.00 per hour when only one residence or location is affected and at the rate of \$500.00 per hour in all other cases that the Engineer determines the Contractor has not complied.

- J. No measurement will be made of the various items that constitute APRs. Payment for all costs of the APRs, including furnishing, installing, maintaining and removing the individual devices, shall be included in the lump sum payment for traffic control.

2564 TRAFFIC SIGNS AND SIGN POST INSTALLATION

A. General

The size of all traffic signs, materials, and posts shall be approved by the Engineer.

B. Material Requirements

All sign faces shall consist of 3-M brand, Diamond Grade DG³ reflective sheeting or approved equal, unless authorized by the City of Duluth.

All traffic signs shall be fastened to sign posts with 316 stainless steel bolts, washers, and Nyloc nuts. The washer shall be separated from sign sheeting by a nylon washer.

All traffic sign posts inserted into soil shall have a weight of three pounds per foot and shall be manufactured of galvanized steel with a minimum length of six feet.

All traffic sign upright posts shall have a minimum weight of two pounds per foot and shall be manufactured of galvanized steel with a minimum length of eight feet.

C. Post Installation

All traffic signs shall be installed to a minimum height of seven feet to the bottom of the sign, with highest priority signage at the top on posts with more than one sign.

All traffic posts installed in sidewalks or concrete surfaces shall conform to Standard Detail T-2, with use of MN/DOT approved/qualified products. All bases shall be located in an area clear of utilities to a distance of two feet in all directions, and a minimum of two feet behind the face of curb.

The City's inspector shall obtain GPS locations of new and moved signs.

D. Basis of Payment

Payment for the installation of traffic signs and devices shall be made at the contract price per unit of measure per MN/DOT 2564.

2564 STREET NAME SIGNS, CONCRETE FOOTING, SIGN POST, AND BRACKET ASSEMBLY

A. General

The concrete footing and sign post shall conform to Standard Detail T-3. The street sign unit E-250 shall conform to Standard Detail T-4. The street sign unit E-450 shall conform to Standard Detail T-5. The street sign unit E-650 shall conform to Standard Detail T-6.

The City's inspector shall obtain GPS locations of new and moved signs.

B. Material Requirements

1. Reflective sheeting shall be 3-M brand, Diamond Grade V.I.P. or approved equal.

2. Length and Width

Mounted name signs shall have a standard width of 9 inches. The length of the face and blade shall be determined by the number of letters in the street name, including the prefixes and suffixes. The nameplate shall have a minimum length of 30 inches or as requested by the Engineer. Where extra length is required, it shall be provided in 6 inch increments.

Unmounted street name faces to be mounted on flat metal sign blades shall have sufficient width and length to permit application and trimming to the finished sign blank 9 inches wide by 30 inches, 36 inches or 42 inches in length.

All 9 inch street name sign plates shall be notched to properly fit the brackets shown on Standard Details T-4, T-5 and T-6; and punched on each end for either stainless bolts (1" long x 1/4" x 20) with nylon and stainless washers and stainless locking nuts, or rivets as approved by the Engineer. The bolts or rivets shall be furnished and installed on each sign unit.

3. Bracket Assembly

The street name bracket assembly shall consist of a post top cap, center rod welded to the post top cap, center clip spacers, and vandal resistant top finial nut.

The post top cap shall be cast iron and of a design which shall fit a round post. The post top cap designed for round posts shall weigh not less than 2.15 pounds each. The post top cap for round post installations shall fit a 2-3/8" O.D. post and shall have two 3/8" x 3/8" Allen set screws capable of providing a secure bond to the post. Post top caps shall have a smooth surface and be painted black.

A 5/8" square steel center tie rod shall be inserted 7/8" into the post cap then welded into the post top cap. The tie rod shall be of the proper length to accommodate either two, four, or six, nine-inch notched street name signs. The tie rod bolt shall be threaded at the top with a standard 5/8"-11 thread with a maximum diameter of .625" and a minimum diameter of .61". The tie rod shall be galvanized after threading to ensure a rust free thread operation.

The sign support holders shall be 18 gauge galvanized steel formed to hold two sign plates within notches formed in the sign plates and fitting over the center tie rod. Sign holders shall be six inches wide and at least 1-1/4" high, providing ample space between the upper and lower sets of sign plates. Each holder shall have a star hole to prevent turning on the center tie rod and shall allow alignment of 45, 90, 135, and 180 degrees. Sign support holders shall be free of burrs and painted black.

Top finial nut shall be cast iron, bored and threaded to fit the 5/8" center tie rod. The finial nut shall have a hole bored on the exterior, 13/64" diameter and 1/4" deep to accommodate a spanner wrench for attachment and removal. The nut shall have a hole drilled and threaded to accommodate a 1/4" - 20 x 1/2" 316 stainless steel Allen set screw which will be used as a vandal resistant device. The finial nut shall have a smooth and burr free surface and be painted black. Anti-seize coating shall be applied to all threaded fittings.

C. Basis of Payment

Payment for furnishing and installing concrete footings, sign post design special and street sign units E-250, 450, and 650 complete with brackets at the contract price per each will be compensation in full for all costs of furnishing and installing the concrete footing, sign post, and street sign.

2564 SIGNS-REMOVE AND REINSTALL

This work shall consist of removal, storage, protection and reinstallation of signs in accordance with the provisions of MN/DOT 2564, and the following:

A. General

All signs that are removed to be reinstalled at a later date will be stored in such a manner as to prevent any damage to the sign and the post. The sign will be installed in the same condition that it was removed. Any traffic sign or street name sign within the project limits that is damaged by construction operations shall be replaced with a new sign by the Contractor at the Contractor's expense.

The City's inspector shall obtain GPS locations of new and moved signs.

B. Measurement

Measurement will be made by each pole for removal and reinstall signs as specified. Multiple pole signs will be measured as a single unit. If more than one sign is attached to a single pole, the pole and signs will be paid as a single unit.

C. Basis of Payment

Payment will be made under Item 2564.602 Signs - Remove and Reinstall at the Contract bid price per each pole, which shall be compensation in full for all costs incidental thereto, including but not limited to: removing and installing the signs; mounting hardware; excavation for footings; concrete and rebar for footings if required; and protecting and storing the signs.

2571 PLANT INSTALLATION AND ESTABLISHMENT – STREET TREES

The provisions of MN/DOT 2571 are supplemented with the following:

A. DESCRIPTION

This work consists of providing, planting, and establishing trees of the species, size, variety and root category specified for locations shown on the plans, and including planting trees provided by the City of Duluth.

Street Trees. This standard applies to ‘Street Trees’ that will be owned/maintained by the City of Duluth within the established roadway right of way. The term ‘Street Trees’ applies to those trees planted along a street/roadway in close proximity to the street, where limits of the road structure (geotextile fabric, subsurface drain, subbase, aggregate base, pavement, curb and gutter, and sidewalk) are within the ‘drip line’ of the anticipated crown spread (or canopy) of the mature tree.

B. MATERIALS

- 1) **Street Tree Planting Zone Soil Treatment** - A soil mixture meeting the requirements of MN/DOT 3877.2.F Boulevard Topsoil Borrow shall provide a 24-inch planting zone treatment in street boulevards and/or within street right of way in accordance with standard details **STR-12** and **STR-13**. Submit a copy of the design mixture of topsoil addressing: soil source(s), blending/mixing procedures, and test reports of sieve analysis at least 3 weeks prior to commencing work.

- 2) **Species Selection and Diversity Guidelines** – Selection of the tree species shall be in accordance with all of the following:
 - a. City Forester’s recommendations. An existing tree survey completed by the City Forester may be necessary prior to issuing recommendation.
 - b. No more than five (5) trees per genera may be on any one block. (i.e. 6 trees = 2 genera; 11 trees = 3 genera; 16 trees = 4 genera).
 - c. For projects less than 50 trees, not more than 50% may be of single genus.
 - d. For projects of 50-100 trees, not more than 50% of single genus, and not more than 30% of a single species.
 - e. For projects greater than 100 trees, not more than 30% of a single genus, and not more than 20% of a single species.
 - f. Trees size/stature shall be determined per Table 2571-1:

Table 2571-1 Acceptable Mature Tree Size/Stature			
Boulevard Width	Small Trees	Medium Trees	Large Trees
less than 5 feet	No	No	No
5 feet to 7 feet	Yes	No	No
7 feet to 9 feet	Yes	Yes	No
greater than 9 feet	Yes	Yes	Yes

3) **Acceptable Tree Species** – Refer to the lists below:

Small Trees (mature height less than 30 feet)

- Eastern wahoo (*Euonymus atropurpureus*)
- Ironwood (*Carpinus caroliniana*)
- Serviceberry – “Autumn brilliance” (*Amelanchier x grandiflora*)
- Musclewood - Firespire (*Carpinus caroliniana* 'J.N. Upright')
- Tree lilacs – Snowdance or Ivory silk (*Syringa reticulata* 'Bailnce' or 'Ivory silk')
- Hawthorn – Crimson cloud (*Crataegus laevigata* 'Crimson Cloud')

Medium Trees (mature height less than 40 feet)

- Buckeye (*Aesculus glabra*)
- Ginkgo (*Ginkgo biloba*)
- Elm – Discovery (*Ulmus davidiana* var. *japonica* 'Discovery')
- Prairie horizon alder (*Alnus hirsuta* 'Harbin')
- Paper birch – Prairie dream (*Betula papyrifera* 'Varen')
- Linden – American Sentry (*Tilia americana* 'McKsentry')
- Sugar maple – Apollo (*Acer saccharum* 'Barrett Cole')

Large Trees (mature height greater than 40 feet)

- Red oak (*Quercus rubra*)
- Hackberry (*Celtis occidentalis*)
- Swamp white oak (*Quercus bicolor*)
- Bur oak (*Quercus macrocarpa*)
- White oak (*Quercus alba*)
- KY Coffeetree (*Gymnocladus dioica*)
- River birch (*Betula nigra*)
- Dutch elm disease resistant American elms: Princeton, Triumph, Prairie expedition, Jefferson (*Ulmus Americana*)
- Basswood (*Tilia americana*)
- Silver maple – Silver queen (*Acer saccharinum* 'Silver queen')
- Red maple (*Acer rubrum*)

C. CONSTRUCTION REQUIREMENTS

The provisions of MN/DOT 2571.3 Construction Requirements are supplemented with the following:

1) **Tree Locations** – Determine planting locations based on the following guidelines:

a) Tree Spacing –

Minimum Spacing between Street Trees – Table 2571-2	
Tree Size/Stature	Min. Distance Tree to Tree
Small	20 feet O.C.
Medium	25 feet O.C.
Large	30 feet O.C.

b) Tree Clearances –

Minimum Clearances for Tree Placement – Table 2571-3	
Element	Min. Distance from Tree O.C.
Traffic signal pole base	75 feet
Stop or yield sign	50 feet
Cross street unmarked	40 feet
Street signs	20 feet
Street light poles	20 feet
Utility poles	20 feet
Fire hydrant	10 feet
Alleys or driveways	10 feet
Catch basin or pipe inlet	10 feet
Underground gas main	5 feet
Underground utility service lines	5 feet
Utility service shutoff and locate boxes	5 feet
Edge of crossing sidewalks	5 feet
Curb and edge of parallel sidewalks	2 feet
Bus stop	Clear of entire loading zone
Overhead power and communication lines	No medium or large trees

- 2) **Plant Installation** - Perform this work in accordance with the current edition of the *Inspection and Contract Administration Manual for MN/DOT Landscape Projects* (ICAMMLP).
- 3) **Standard Planting Details** – Refer to the current version of the MN/DOT Standard Plan 5-297.301 (3 sheets).
- 4) **Protection and Restoration of Vegetation** – Refer to the current version of the MN/DOT Standard Plan 5-297.302 (1 sheet).

2572 PROTECTION AND RESTORATION OF VEGETATION

The provisions of MN/DOT Specification 2572, Protection and Restoration of Vegetation, shall apply to this contract except where otherwise defined in the Contract Special Provisions, and as amended below:

Contractor shall consult with the City Forester, or designee, prior to beginning any construction activities to identify, verify, and establish concurrence with plan of tree removal, preservation, and protection.

Preserved trees shall be protected from direct damage and soil compaction in accordance with MN/DOT Standard Specifications for Construction, 2572.3A Protecting and Preserving.

The provisions of MN/DOT Specification 2572.3A8, Destroyed or Disfigured Vegetation, is amended below:

Damage to preserved trees on public property by contractors through negligence or non-compliance with the City's Standard Construction Specifications may be subject to a fine established by the Tree Inspector per the *Council of Tree and Landscape Appraisers – Guide for Plant Appraisal*. A copy of this guide is available for review in the City Engineering Office, 211 City Hall.

2573 STORM WATER MANAGEMENT

Revised 01/25/19

SP2018-242: MN/DOT 2573 is modified as follows:

1. The pay item table in MN/DOT 2573.5.I, "Pay Items," is deleted and replaced with the following:

Item No.	Item	Unit
2573.501	Erosion Control Supervisor	lump sum
2573.501	Water Treatment	lump sum
2573.501	Stabilized Construction Exit	lump sum
2573.501	Storm Drain Inlet Protection.....	lump sum
2573.502	Culvert Inlet End Control	each
2573.502	Flocculant Sock	each
2573.502	Storm Drain Inlet Protection.....	each
2573.502	Water Treatment Type ____	each
2573.502	Wheel Wash Off	each
2573.503	Bale Barrier	linear foot
2573.503	Filter Berm Type ____	linear foot
2573.503	Floatation Silt Curtain, Type ____	linear foot
2573.503	Sediment Control Log Type ____	linear foot
2573.503	Silt Fence, Type ____	linear foot
2573.503	Temporary Slope Drain	linear foot
2573.506	Liquid Flocculant	gallon
2573.507	Sediment Trap Excavation	cubic yard
2573.508	Granular Flocculant.....	pound
2573.510	Sediment Removal, Backhoe	hours
2573.510	Sediment Removal, Vac Truck	hours
2573.518	Sandbag Barrier	square foot

2. The following is ADDED to MN/DOT 2573.5, "Basis of Payment":

J Unit Prices

In addition to stormwater management practices shown in the plan the Engineer may require additional items as site conditions warrant. Payment for additional items as ordered by the Engineer will be made in accordance with the following schedule:

Bale Barrier	\$5.50 /foot
Silt Fence, Type HI	\$4.50/ foot
Silt Fence, Type MS.....	\$2.25/ foot

Silt Fence, Type SD	\$20.00/ foot
Sandbag Barrier	\$8.00 square foot
Flotation Silt Curtain, Type: Still Water, 1.2 m (4 foot) depth	\$16.00 /foot
Sediment Trap Excavation	\$10.00/cubic yard
Bituminous Lined Flume	\$65.00/square yard
Sediment Removal, Backhoe	\$185.00/ hour
Sediment Removal, Vacuum truck	\$260.00 /hour
Sediment Control Log, Type Wood Fiber	\$4.00/foot
Sediment Control Log, Type Rock.....	\$5.00/foot
Flocculant Sock	\$265 each

2573 EROSION CONTROL SUPERVISOR

Section 2573.5H is deleted and replaced by the following:

H Erosion Control Supervisor

Providing the Erosion Control Supervisor for this Contract shall be considered incidental work for which no direct payment will be made.

2574 SOIL PREPARATION

Revised 12-08-17

SP2018-243: MN/DOT 2574 is modified as follows:

The following is added to MN/DOT 2574.5 Basis of Payment:

C Unit Prices

In addition to soil preparation practices shown in the Plan, the engineer may require additional items as site conditions warrant. Payment for additional items as ordered by the Engineer will be made in accordance with the following schedule:

Subsoiling	\$400.00 /acre
Soil Bed Preparation	\$260.00/ acre
Soil Tracking	\$300.00 /acre

2575 ESTABLISHING TURF AND CONTROLLING EROSION

Revised 04-20-18

SP2018-244: MN/DOT 2575 is modified as follows:

1. MN/DOT 2575.3.C.3, "Type 4 Mulch," is deleted and replaced with the following:

C.3 Type 4 Mulch

Apply Type 4 mulch as a dual operation with the Type 1 mulch blown on the soil surface at 1 ½ tons per acre and immediately over-spray with 3884, Hydraulic Stabilized Fiber Matrix at 750 lbs. per acre.

2. MN/DOT 2575.3.G.5 is deleted and replaced with:

G.5 Placing Flexible Concrete Geogrid Mat

Shape and prepare the site in accordance to 2574, "Soil Preparation" or as shown in the plan.

Furnish and install Flexible Concrete Geogrid Mat at the locations specified on the plans according to the standard specifications, the manufacturer's installation guidelines and in accordance with 3885. Prepare the subgrade as smooth and free of all rocks, stones, sticks, roots, other protrusions, or debris of any kind. The prepared surface shall provide a firm unyielding foundation for the mats with no sharp or abrupt changes or breaks in the grade. Apply seed directly to the prepared soil prior to installation of the Flexible Concrete Geogrid Mat. Install Flexible Concrete Geogrid Mat to the line and grade shown on the plans and according to the manufacturer's installation guidelines for head and side trenching, shingle overlap, and rebar anchoring spacing.

3. The following is added to MN/DOT 2575.5, "Basis of Payment":

M Unit Prices

In addition to Erosion Control practices shown in the plan the engineer may require additional items as site conditions warrant. Payment for additional items as ordered by the engineer will be made in accordance with the following schedule:

Disc anchoring	\$82.00/ acre
Seed Mixtures (for temporary use)	
21-111 or 21-112	\$1.75/ pound
21-113	\$2.25 /pound
22-111	\$2.70 /pound
Erosion Control Blanket	
Category 3N	\$2.00/square yard
Category 4N	\$2.25/square yard
Rapid Stabilization	
Method 1	\$500/acre
Method 2	\$1000/acre
Method 3	\$726.00/M gallon
Method 4	\$2.50/sq yd
Hydraulic Mulch	\$1.70/lb
Hydraulic Stabilized Fiber Matrix	\$1.90/lb
Hydraulic Reinforced Fiber Matrix	\$2.00/lb
Water	\$42.00/M gallon
Mowing	\$260.00
Weed Spraying	\$60.00

2575 TURF ESTABLISHMENT

Turf establishment shall be performed in accordance with the provisions of MN/DOT 2575, except as modified below:

- A. Lawn type sod shall be placed on all disturbed turf areas in well- established lawns and around all culvert ends and storm sewer inlets and outlets as directed by the Engineer.
- B. Where the new sod meets the existing, a sod cutter shall be used to make the new sod level with the existing and to eliminate the ragged appearance of the existing sod caused by excavation.
- C. Areas of disturbed soil located on private property will be topsoiled and sodded immediately after the underlying work is completed. No additional compensation will be made for this early sodding.
- D. Topsoil salvage material shall be placed to a thickness of 4 inches on all disturbed turf areas to be sodded and seeded in accordance with the provisions of MN/DOT 2105. Where the salvage topsoil material found on site is inadequate, topsoil borrow shall be provided in turf establishment areas in accordance with the provisions of MN/DOT 2574.
- E. Turf establishment on disturbed turf areas not designated for sodding shall consist of seeding, fertilizing and mulching. Unless otherwise provided in the Plans, turf establishment by seeding shall include:
 - 1. Seed, Mixture No. 25-151 (High Maintenance Turf) as specified in MN/DOT 3876, shall be applied at the rate of 120 pounds per acre.
 - 2. Fertilizer, Type 3, (analysis 22-5-10) as specified in MN/DOT 3881 shall be applied at the rate of 350 pounds per acre.
 - 3. Hydraulic Matrix, Type FRM as specified in MN/DOT 3884 shall be applied at the rate of 3,900 pounds per acre.
- F. Seed shall be placed with a hydro-seeder, unless otherwise approved by the Engineer.
- G. Final acceptance of turf establishment will not be made until area restored has a satisfactory stand of grass established. Project payment retainage will be held until final acceptance of turf establishment.
- H. Payment for sodding at the contract price per square yard shall include importing or salvaging and placing 4 inches of topsoil, shaping, or otherwise preparing the ground, cutting as required, furnishing, laying the sod on the areas designated to be covered, and pressing the sod into the underlying soil by rolling or tamping, and staking or stapling as necessary for sloped areas.
- I. Payment for turf establishment shall include importing or salvaging and placing 4-inches of topsoil, shaping, or otherwise preparing the ground, seeding, fertilizing and hydro-mulching the disturbed turf areas not designated for sodding. Final acceptance of turf establishment will not be made until the area restored has a satisfactory stand of grass established. A satisfactory stand of grass shall be defined as a consistent root of growth 3-inches or more. Root growth shall be determined on a random sample basis of plugs taken by the engineer when the contractor determines that the root growth has been obtained. Turf will not be accepted until the minimum root growth has been obtained.
- J. Upon expiration of the sod maintenance period on individual areas or sections of the Project, the Engineer will make an inspection of the work and will accept all sod that is in normal, healthy growing condition. No payment will be made for sod that is not in acceptable condition at the time of the final inspection an amount will be deducted from any moneys due or that may become due the Contractor equal to 100 percent of the Contract bid price per unit of measure of unacceptable sod. Sod that is within 3 m (10 feet) of the shoulder or is

directly abutting a roadway surface that is acceptably maintained, but dies out due to salt or winter maintenance activities beyond the Contractor's control, may be paid for at 100 percent of Contract price provided that the sod has been maintained for at least 20 calendar days prior to December 1."

3105 BAGGED PORTLAND CEMENT CONCRETE PATCHING MIX GRADE 3U18 AND 3U18M

Revised 12-08-17

SP2018-251: MN/DOT 3105 is deleted and replaced with the following:

3105 BAGGED PORTLAND CEMENT CONCRETE PATCHING MIX GRADE 3U18 AND 3U58M

3105.1 SCOPE

Provide dry, bagged concrete patching mix 3U18 for repairing Portland cement concrete pavement and 3U58M for repairing portland cement concrete bridge decks, bridge deck overlays and approach panels.

3105.2 REQUIREMENTS

A Materials

Provide materials for patching mix meeting the following requirements:

A.1 Cement 3101

A.2 Fine Aggregate 3126

A.3 Coarse Aggregate 3137

A.4 Blank

A.5 Admixtures.....3113
Mix 3U58M utilizes air entraining and water reducing admixtures. Provide the manufacturer’s Technical Data Information Sheet and the Materials Safety Data Sheet (MSDS) for the proposed dry admixtures when submitting the Quality Plan for approval.

B Quality Control (QC) Program

Prior to producing concrete patching mix each construction season, a Department Representative shall perform a thorough on-site inspection of the plant with a MN/DOT Certified Plant Level 1 or Level 2 Technician representing the Producer.

Maintain an approved Quality Control Program, including a Quality Plan, for the production of Bagged Portland Cement Concrete Patching Mix.

The Producer will perform Quality Control (QC) as part of the production of Grade 3U18 concrete.

The Engineer will perform Quality Assurance (QA) as part of the acceptance process.

B.1 Quality Plan Requirements

Submit a quality control plan to the Concrete Engineer for review and approval prior to producing Grade 3U18 and Grade 3U58M. The Quality Plan includes the following QC Procedures:

- (a) Moisture Content
- (b) Batch Weight Verification
- (c) Aggregate Gradation Testing
- (d) Blending
- (e) Addition of dry admixtures to 3U58M
- (f) Documentation and Submittals

B.2 MN/DOT Certified Personnel

Provide a MN/DOT Concrete Plant 1 or Concrete Plant 2 Technician to perform moisture content and aggregate gradation testing. Provide a MN/DOT Concrete Plant Level 2 Technician to review batch tickets, test results, and oversee all quality control requirements of 3105 and the QC Program.

B.3 Daily Production Requirements

Each day Grade 3U18 or 3U58M is produced:

- (a) Perform moisture content and gradation testing on all aggregates and complete MN/DOT's *Bagged Mix Quality Control Worksheet*.
- (c) The Producer's Plant Level 1 or Plant Level 2 Technician will review and sign the *Bagged Quality Control Worksheet*.
- (d) Electronically submit all *Bagged Quality Control Worksheets* and batch tickets to MN/DOT the day following production.

C Mix Proportioning

Proportion the mix in accordance with Table 3105-1. Use of any other size bag requires approval of the Concrete Engineer.

Table 3105-1 Mix Proportions				
		Weight, <i>lb.</i>		
Material	Gradation Requirements	50 lb. bag	75 lb. bag	3000 lb. bag
Type I Cement	-	11.9	17.8	712
Coarse Aggregate	CA-80	18.9	28.3	1132
Fine Aggregate	MN/DOT 3126	19.3	28.9	1156

D Blending

Dry the coarse and fine aggregates as approved by the Engineer before blending with the cement. Blend all materials completely before bagging the mix.

Provide a blending device meeting the following characteristics and requirements:

- (1) Capable of producing the required mix proportions within ± 2 percent,
- (2) Equipped with a warning device to indicate when the system is out-of-tolerance,

- (3) Capable of stopping the flow of cement to allow sampling of the blended coarse and fine aggregate, and
- (4) Designed to allow cement and aggregate to discharge separately for checking material weights.

E Bags and Batch Identification

Provide moisture-proof bags resistant to tearing.

Print the following on the bags:

- (1) The phrase, "MN/DOT 3U18 CONCRETE PATCH MIX" or "MN/DOT 3U58M CONCRETE PATCH MIX"
- (2) Weight of the bag in pounds [kilograms]
- (3) Mix date
- (4) Mixing instructions

3105.3 SAMPLING AND TESTING

The Producer and Engineer will sample and test in accordance with the Schedule of Materials Control.

3135 MODIFIED AGGREGATE BASES

Revised 12-08-17

SP2018-252: MN/DOT 3135 is deleted and replaced with the following:

3135 AGGREGATE BASE FOR RECLAMATION

3135.1 SCOPE

This specification lists the quality requirements for aggregate base.

3135.2 REQUIREMENTS

A General

Produce aggregate materials that have uniform: appearance, texture, moisture content, and performance characteristics.

B Gradation

Table 3135-1 Gradation Requirements	
Sieve Size, in	Percent Passing
3	99 - 100
2	97 - 100
Note 1: Exclude rock that is larger the 2 inches, in the gradation calculations, when it originates from material below the reclaimed bituminous pavement.	

C Add Materials

Supply materials as required by the contract.

3135.3 SAMPLING AND TESTING

Test the mixture at the rates specified in the Schedule of Materials Control.

3137 COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE

Revised 01/04/19

SP2018-252.1: MN/DOT 3137 is hereby supplemented as noted in Appendix E – “Supplemental Concrete Specifications” of these Construction Standards.

3138 AGGREGATE FOR SURFACE AND BASE COURSES

Revised 12-05-18

SP2018-252.2: MN/DOT 3138 is hereby modified as follows:

1. Replace Table 3138-1 with the following:

Table 3138-1 Quality Requirements for Virgin Materials				
Requirement	Class			
	1 and 2	3 and 4	5 and 5Q	6
Max Shale, if No. 200 ≤ 7% by mass	NA	10.0%	10.0%	7.0%
Max Shale, if No. 200 > 7% by mass	NA	7.0%	7.0%	7.0%
Minimum Crushing Requirements *	NA	NA	10%	15%
Maximum Los Angeles Rattler (LAR) loss from carbonate quarry rock	40%	40%	40%	35%
Maximum Insoluble residue for the portion of quarried carbonate aggregates passing the No. 200 sieve	10%	10%	10%	10%
Maximum amount of Brick	1.0% #			
Maximum amount of other objectionable materials including but not limited to: wood, plant matter, plastic, plaster, and fabric	0.3% #			
* Material crushed from quarries is considered crushed material.				
# The Contractor/Supplier may not knowingly allow brick and other objectionable material and must employ a QC process to screen it out, before it becomes incorporated into the final product.				

2. Replace Table 3138-3 with the following:

Table 3138-3 Base and Surfacing Aggregate (containing less than 25 percent recycled aggregates) Total Percent Passing *							
Sieve Size	Class 1 (Surfacing £)	Class 2 (Surfacing β)	Class 3 (Subbase)	Class 4 (Subbase)	Class 5 (Base)	Class 5Q (Base)	Class 6 (Base)
2 in	—	—	100	100	—	100	—
1½ in	—	—	—	—	100	—	100
1 in	—	—	—	—	—	65 - 95	—
¾ in	100	100	—	—	70 - 100	45 - 85	70 - 100
⅝ in	65 - 95	65 - 90	—	—	45 - 90	35 - 70	45 - 85
No. 4	40 - 85	35 - 70	35 - 100	35 - 100	35 - 80	15 - 52	35 - 70
No. 10	25 - 70	25 - 45	20 - 100	20 - 100	20 - 65	10 - 40	20 - 55
No. 40	10 - 45	12 - 35	5 - 50	5 - 35	10 - 35	5 - 25	10 - 30
No. 200	8.0 - 15.0	5.0 - 16.0	5.0 - 10.0	4.0 - 10.0	3.0 - 10.0	0.0 - 10.0	3.0 - 7.0
* If product contains recycled aggregate, add letters in parentheses for each aggregate blend designating the type of recycled products included in the mixture. (B) = Bituminous, (C) = Concrete, (G) = Glass (BC) = Bituminous and Concrete, (BG) = Bituminous and Glass (CG) = Concrete and Glass, (BCG) = Bituminous, Concrete, and Glass £ Recycled concrete when used for surfacing is only allowed for shoulders β Class 2 must be composed of 100% crushed quarry rock per 3138.2.B.2.							

3. Replace Table 3138-4 with the following:

Table 3138-4 Base and Surfacing Aggregate (containing 25% or more recycled aggregates & 75% or less recycled concrete) Total Percent Passing *						
Sieve Size	Class 1 (Surfacing £)	Class 3 (Subbase)	Class 4 (Subbase)	Class 5 (Base)	Class 5Q (Base)	Class 6 (Base)
2 in	—	100	100	—	100	—
1½ in	—	—	—	100	—	100
1 in	—	—	—	—	65 - 95	—
¾ in	100	—	—	70 - 100	45 - 85	70 - 100
⅝ in	65 - 95	—	—	45 - 90	35 - 70	45 - 85
No. 4	40 - 85	35 - 100	35 - 100	35 - 80	15 - 52	35 - 70
No. 10	25 - 70	20 - 100	20 - 100	20 - 65	10 - 40	20 - 55
No. 40	10 - 45 † 5 - 45	5 - 50	5 - 35	10 - 35	5 - 25	10 - 30
No. 200	5.0 - 15.0 † 0 - 15.0	0 - 10.0	0 - 10.0	0 - 10.0	0 - 10.0	0 - 7.0
* Add letters in parentheses for each aggregate blend designating the type of recycled products included in the mixture. (B) = Bituminous, (C) = Concrete, (G) = Glass (BC) = Bituminous and Concrete, (BG) = Bituminous and Glass (CG) = Concrete and Glass, (BCG) = Bituminous, Concrete, and Glass † Note: For Class 1, if the bitumen content is ≥ 1.5%, the gradation requirement is modified to 5-45% for the #40 sieve and 0 - 15.0% for the #200 sieve. £ Recycled concrete is only allowed for shoulders						

4. Add the following to MN/DOT 3138.2.E:

- (6) The Contractor may substitute reclamation material (recycled bituminous and aggregate) for class 3, 4, 5, or 6, if used for base, subbase, stabilizing aggregate, or fine aggregate bedding. Meet the gradation in Table 3138-6, and the all other requirements of 3138.

Table 3138-6 Reclamation Material Permitted as a Substitute for Class 3, 4, 5, or 6 Total Percent Passing				
Sieve Size	Class 3	Class 4	Class 5	Class 6
3" *	100	100	100	100
¾"	---	---	70 - 100	70 - 100
#3/8"	---	---	45 - 90	45 - 85
#4	35 - 100	35 - 100	35 - 80	35 - 70
#10	20 - 100	20 - 100	20 - 65	20 - 55
#40	5 - 50	5 - 35	10 - 35	10 - 30
#200	0 - 10.0	0 - 10.0	0 - 10.0	0 - 7.0
* Note for bedding within 2 feet of plastic pipe the requirement is 100% passing the 1" sieve.				

3151 BITUMINOUS MATERIAL (MSCR)

The provisions of MN/DOT 3151 are modified with the following:

A Asphalt Binder

Only use Performance Graded (PG) Asphalt Binder meeting the requirements of AASHTO M 332, Table 3151-1A, and the Combined State Binder Group Method of Acceptance for Asphalt Binder, available on the Asphalt Products page of the Approved/Qualified Products List.

Table 3151-1A Multi Stress Creep Recovery (MSCR) Test Requirements				
Grade*	Binder Code for 2360 Mix Design	Jnr@3.2kPa, maximum	%R @ 3.2kPa, min.**	Jnr Difference (max.per M 332)***
PG 58S-28	B	4.5	N/A	report (75)
PG 58H-28	E	2.0	30 %	report (75)
PG 58V-28	H	1.0	55 %	report (75)
PG58E-28		0.5	75 %	report (75)
PG58S-34		4.5	N/A	report (75)
PG58H-34	C	2.0	30 %	report (75)
PG58V-34	F	1.0	55 %	report (75)
PG58E-34	I	0.5	75 %	report (75)
PG49S-34	M	4.5	N/A	report (75)
PG52S-34	A	4.5	N/A	report (75)
PG64S-22	L	4.5	N/A	report (75)
* LTPP Bind temperature for Minnesota is 58°C for the high PG Binder Grade temperature. The bottom three grades are special use binders and are to be tested at the high temperature indicated by the grade (example: PG 49S-34 is tested @ 49C). ** Use in place of Appendix X1 in AASHTO – M 332. *** Jnr Difference is waived for “E” grade binders.				

Use asphalt binder supplier recommendations for mixing and compaction temperatures.

3236 REINFORCED CONCRETE PIPE

Revised 12-08-17

SP2018-255: The provisions of MN/DOT 3236 are modified and/or supplemented with the following:

Manufacturers of reinforced concrete pipe may produce an alternate "offset joint" on the spigot end of the pipe. This type of offset joint is to be used with the profile or pre-lubricated pipe seal systems. See MN/DOT Standard Plate 3006.

3245 THERMOPLASTIC PIPE

Revised 09-14-18

SP2018-255.1: Replace MN/DOT 3245 is replaced with the following:

3245 THERMOPLASTIC PIPE

3245.1 SCOPE

Provide thermoplastic (TP) pipe and fittings for use as pipe sewers or subsurface drains.

3245.2 REQUIREMENTS

Provide thermoplastic pipe and fittings meeting the requirements of the Contract. If pipe is not specified in the Contract, provide one of the following pipes listed below meeting the applicable application, i.e. use perforated pipe for drainage application and unperforated pipe for outletting into ditch, etcetera.

If perforated pipe is specified, provide pipe with perforations in accordance with the applicable specification.

Unless otherwise specified, the Contractor may choose the joint type.

Create all perforations at manufacture's plant; no field perforations are allowed.

- (1) AASHTO M 278, Class PS 46, Polyvinyl Chloride (PVC) Pipe (perforated and unperforated),
- (2) Blank,
- (3) ASTM D 3034, Type PSM PVC Sewer Pipe, SDR 35, (unperforated only),
- (4) ASTM F 758, Smooth-Wall PVC, Type PS 46 (perforated and unperforated),
- (5) ASTM F 949, PVC Corrugated Sewer Pipe (perforated and unperforated),
- (6) ASTM D1785, Schedule 40 pipe (perforated & unperforated as applicable with one of the following:
 - a. Perforated: Slotted with maximum slot width of 1/16 inch and minimum slot area of 1.5 in²/linear foot for pipe 4 inches in diameter and greater and 1.0 in²/linear foot for pipe less than 4 inches in diameter,
 - b. Perforated: Circular holes with two to four rows of holes. Hole diameter = 3/16 inch - 3/8 inch, and minimum area of holes 1.5 in²/linear foot for pipe 4 inches in diameter and greater and 1.0 in²/linear foot for pipe less than 4 inches in diameter,
 - c. Unperforated, or
- (7) AASHTO M 252, Corrugated Polyethylene (CP) dual-wall, Type "S" (unperforated) or "SP" (perforated) pipe, PS 50.

3245.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance with each pipe shipment.

3247 CORRUGATED POLYETHYLENE PIPE

Revised 12-08-17

SP2018-256: The third paragraph of MN/DOT 3247.3 is replaced with the following:

Submit a manufacturer's Certificate of Compliance with each pipe shipment including date manufactured, nominal and actual inside pipe diameters.

3248 POLYVINYL CHLORIDE PIPE

Revised 12-08-17

SP2018-257: The third paragraph of MN/DOT 3248.3 is replaced with the following:

Submit a manufacturer's Certificate of Compliance with each pipe shipment including date manufactured, nominal and actual inside pipe diameters.

3278 CORRUGATED POLYETHYLENE DRAINAGE TUBING

Revised 05-18-18

SP2018-257.1: Replaced MN/DOT 3278 with the following:

3278 CORRUGATED POLYETHYLENE DRAINAGE TUBING

3278.1 SCOPE

Provide corrugated polyethylene (PE) tubing and fittings.

3278.2 REQUIREMENTS

Create all perforations at manufacture's plant; no field perforations are allowed.

- (A) For all uses except the 2 inch perforated pipe shown on the bridge approach panel standard plan sheets: Provide corrugated polyethylene (PE) tubing and fittings meeting the requirements of AASHTO M 252.
- (B) For the 2 inch perforated pipe shown on the approach panel sill shown on the bridge approach panel standard plan sheets, provide corrugated and slotted drain pipe meeting the requirements listed in Table 3278-1.

Table 3278-1	
Requirements of 2" Perforated Pipe used for Bridge Approach Panels	
Minimum Water Inlet Area	0.50 in ² /ft
Maximum Slot Width	0.04 in

Table 3278-1 Requirements of 2" Perforated Pipe used for Bridge Approach Panels	
Minimum Pipe Stiffness @ 5% Deflection	30 psi
ASTM D3350 Cell Classification	323410C
Manufacture to the following requirements	ASTM F667
Inside Diameter	1.95 – 2.05 in
Wall Thickness Minimum	0.023"

3278.3 SAMPLING AND TESTING

Submit to the Engineer a manufacturer's Certificate of Compliance with each tubing shipment.

3301 REINFORCEMENT BARS

REVISED 12-08-17

SP2018-258: MN/DOT 3301 is modified with the following:

The following is added to MN/DOT 3301.2 Requirements:

Fabrication of epoxy-coated reinforcing steel delivered to projects in 2019 and later is required to take place in plants participating in CRSI Epoxy Coated Fabrication Certification Program and listed on CRSI's website.

3302 DOWEL BAR

REVISED 12-08-17

SP2018-259: MN/DOT 3302 is modified with the following:

1. MN/DOT 3302.2.B is hereby deleted and replaced with the following:

B Galvanized Tubular Dowel Bars

Provide welded carbon and alloy Grade 60 steel tubular dowel bar meeting the requirements of ASTM 513 and Table 3302-1.

Table 3302-1 Tubular Dowel Bar Requirements		
Specified Dowel Bar Diameter	Required Tubular Dowel Bar Outside Diameter	Required Tubular Dowel Bar Wall Thickness
1.25 in	1.3125 in or 1.375 in	0.120 in
1.50 in	1.62 in	0.120 in

The galvanized coating must provide a minimum 20 year life in accordance with the *Zinc Coating Life Predictor* available on the American Galvanizers Association website. Cap the ends of the tubular dowel bar in a way to prevent intrusion of concrete or other materials.

Galvanize the exterior and interior of the tubular dowel bars meeting one of the following:

- (1) G40 coverage zinc galvanized coating, or
- (2) G90 coverage zinc galvanized coating

Epoxy coat the exterior of the G40 galvanized tubular dowel bars in accordance with AASHTO M254 with 7-13 mils epoxy coating thickness.

3760 INSULATION BOARD (POLYSTYRENE)

The provisions of MN/DOT 3760 are supplemented with the following:

A. Materials

Insulation board shall be extruded polystyrene foam designed for use in high load underground applications. Insulation board shall comply with ASTM C578 Type VI specifications. Insulation board shall meet the following minimum requirements:

Compressive Strength	=	Min. 40 psi
Water Absorption	=	less than 0.3% volume
Water Vapor Permeability	=	less than 1.1 perms

Thickness specified may be made up by layering 1 inch, 1-1/2 inch or 2 inch thick sheets provided the overlaying joints are offset from those below.

Insulation board shall be similar or equal to "DiversiFoam Products CertiFoam 40", "DOW STYROFOAM HIGHLOAD 40", or "Owens Corning FOAMULAR 400, XPS."

B. Placement of Polystyrene Insulation

This work shall consist of furnishing and installing 3 inches of total combined thickness of insulation board at the locations designated on the Contract Drawings. This work shall be performed in accordance with the Standard Details, the Contract Drawing and the Special Provisions, the applicable MN/DOT Standard Specifications, and the following:

Rigid insulation board shall be placed within the pipe encasement zone, 6 inches above the pipe. Prior to placement of the insulation, encasement material shall be compacted until there is no further evidence of increased consolidation or the density of the compacted layer conforms to the density required in the Special Provisions, then leveled and lightly scarified to a depth of 1/2 inch. Encasement zone material placed below the insulation shall be free of rock or stone fragments measuring 1-1/2 inches or greater.

Insulation boards shall be furnished in panels 1-inch thick, 1-1/2 inch thick or 2 inch thick, and shall be placed on the scarified material with the long dimension parallel to the centerline of the pipe. Boards placed in a single layer shall be overlapped at least 6 inches on all sides to eliminate continuous joints for the full depth of the insulation. If two or more layers of insulation boards are used, each layer shall be placed to cover the joints of the layer immediately below with an overlap of at least 6 inches. The edges shall be trim and square.

A minimum of two (2) wood skewers per board in each layer driven flush with the surface of the material shall be utilized to hold the insulation material in-place during the backfill operations.

The Contractor shall exercise precaution to ensure that all joints between boards are tight during placement and backfilling with only extruded ends placed end to end or edge to edge.

The placement of the backfill material over the insulation board and compaction thereof shall be accomplished in a manner that will preclude damage to the insulation material. The first layer of material placed over the insulation shall be 6 inches in depth, free of rock or stone fragments measuring 1-1/2 inches or greater. The material shall be placed in such a manner that construction equipment of any kind does not operate directly on the insulation and shall be compacted with equipment which exerts a contract pressure of less than 80 psi. Sections of insulation board damaged by the Contractor's construction operations shall be replaced at the Contractor's own expense. The first layer shall be compacted until there is no further evidence of increased consolidation or the density of the compacted layer conforms to the requirements of 2451 EXCAVATION, BACKFILL AND COMPACTION FOR UTILITIES.

C. Measurement and Payment

Insulation will be measured separately by the area in square yards of polystyrene insulation board furnished and installed to the thickness specified on the Contract Drawings, Special Provisions or Standard Details. Compensation for insulation shall include all costs of extra trench excavation, overlap of insulation board, furnishing and placing granular backfill, and removal and disposal off the site of excess excavated material.

Payment will be made under Item 2504.604 3-inch Polystyrene Insulation at the Contract bid price per square yard, which shall be compensation in full for all costs incidental thereto including, but not limited to the providing insulation board, extra trench excavation, bedding preparation, insulation board installation, furnishing and placing granular backfill and removal and disposal off the site of excess excavated material.

- END -



City of Duluth, Minnesota

Public Works & Utilities Department - Engineering Division

Standard Construction Specifications - 2019 Edition

APPENDIX A

**STANDARD SPECIFICATIONS
FOR HIGH PRESSURE GAS MAINS, TRANSMISSION LINE
AND SERVICE INSTALLATION, WELDING QUALIFICATIONS, AND
QUALIFICATIONS FOR JOINING PE PIPE**

APPENDIX A

STANDARD SPECIFICATIONS

**FOR HIGH PRESSURE GAS MAINS, TRANSMISSION LINE AND SERVICE INSTALLATION,
WELDING QUALIFICATIONS, AND QUALIFICATIONS FOR JOINING PE PIPE**

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Gas Utility Standard Details are in Appendix D Standard Detail
Drawings of this Construction Standards manual.

GAS OPERATION & MAINTENANCE MANUAL

SECTION 10: DISTRIBUTION LINE VALVES (192.747)

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SECTION 10: DISTRIBUTION LINE VALVES (192.747)

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10.01 Installation Criteria for Distribution Line Valves (192.181)

- A. At a spacing so as to isolate less than 500 customers for sectionalizing valves and 100 customers for operating valves
- B. At plastic branch mains off steel mains
- C. At branch mains off 4" or larger mains
- D. At inlet and outlet piping of regulator station to permit its operation in the event of an emergency at the station. Valves shall be installed at a minimum distance of 25 feet from regulator station unless designated otherwise by Engineering.
- E. At each end of 2" mains, which loop between larger feeder mains.

10.02 Valve Types/Uses

<u>TYPE</u>	<u>USES</u>
PE Valves, ball type all sizes	Underground on PE mains and/or services
Steel gate valves with resilient seating	Below grade as line valves or branch valve off a steel system Meter stop valves - 2" plus Above grade at regulator station
Steel gate valves without resilient seating	Bypass facilities
Steel Plug Valves	Above grade as meter stop valves
Steel Ball Valves	Above grade at regulator station Below grade as line valve or branch valve

Existing valves, when replaced, should conform to the above policy.

GAS OPERATION & MAINTENANCE MANUAL

SECTION 14: MATERIAL REQUIREMENTS FOR HP GAS PIPELINES

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14.01 General

This section of the Standard Specifications establishes requirements and policies for the materials of construction of high pressure gas distribution systems operating at pressures ranging from 1 psig to 275 psig and a transmission line which operates at a pressure ranging from 550 psig to 974 psig. Low pressure gas mains and services, the remaining systems of which were abandoned in 1992, are only specified to the extent of involvement with high pressure construction, such as conflicts in location, abandonments, etc.

All excavation, backfilling and restoration and horizontal direction drilling required for the construction of high pressure gas distribution systems shall be performed in accordance with the City of Duluth, Minnesota Public Works & Utilities Department – Engineering Division, Standard Construction Specifications, most current edition.

For contracted projects, these specifications also establish responsibilities between the Contractor and the Department for supplying materials and providing labor and equipment for installations. The Plans and Special Provisions may change these responsibilities for particular projects; therefore, it is essential that those parts of the documents be carefully reviewed for each project, since they take precedence over this Standard Specification.

14.02 General Material Requirements

All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade, and other details indicated in the Contract. Unless otherwise indicated, all required materials shall be furnished by the Contractor. If any options are provided for as to type, grade, or design of the material, the choice shall be limited as may be stipulated in the Plans, Proposal, or Special Provisions.

All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Plans. Otherwise, the Department may require advance approval of material suppliers, product design, or other unspecified details as it deems desirable for maintaining adopted standards.

14.03 High Pressure Gas Pipe

All pipe furnished for gas main and branch line installation shall be of the type, kind, size, and class indicated for each particular line segment as shown in the Plans and designated in the Contract Items.

Normal pressure range is 10 psig to 275 psig for distribution and 550 to 974 psig for transmission.

Minimum number of samples taken for acceptance/rejections testing by the Department will be based on the current Military Standard 105 D entitled SAMPLING PROCEDURES AND TABLES FOR INSPECTION BY ATTRIBUTES. The sampling plan consists of: General Inspection Level II, Single Sampling, Normal Inspection, and an Acceptable Quality level of 2.5; failure to pass this inspection is the minimum basis for rejection of lot. Rejected material shall be returned to supplier at supplier's expense.

Supplier shall certify with each shipment that the material shipped has been inspected by the supplier and conforms to the Material Specification.

14.03.01 Steel Gas Main Pipe (1 1/2"-16") and Fittings

One and one half inch and two-inch steel gas main pipe shall be class 1; grade B; seamless, electric weld or submerged-arc weld steel pipe, conforming to the 42nd Edition of API Standard 5 L Specifications for Line Pipe and as specified herein.

Steel gas main pipe in diameters 3-inch through 16-inch shall be class 1; grade B, X42, or X52; seamless, electric weld or submerged-arc weld steel pipe, conforming to the 42nd Edition of API Standard 5 L Specifications for Line Pipe and as specified herein.

Pipe shall be in double random lengths. Ends beveled 30°, +5°, -0° for butt weld joining.

The minimum wall thickness and the standard wall thickness are specified in the following table. Standard wall thickness should be used unless specified otherwise by the Engineering Division. Changes to wall thickness shall be based upon the calculations contained in O&M Section 03.04.

Nominal Size Inches)	OD (Inches)	Least Nominal Wall Thickness (Inches)	Standard Wall Thickness (inches)
1 1/2	1.900	0.145	0.145
2	2.375	0.154	0.154
3	3.500	0.216	0.216
4	4.500	0.237	0.237
6	6.625	0.280	0.280
8	8.625	0.250	0.322
10	10.750	0.250	0.365
12	12.750	0.250	0.375
16	16.000	0.250	0.375

Exterior pipe coating shall be factory applied thin film epoxy or fusion bonded epoxy (FBE). Thin film epoxy shall be from manufacturer's chart below. Thin film epoxy shall be applied according to the manufacturer's standards and recommendations, and

conforming to the National Association of Pipe Coating Applicator's Specification 12-78-90. Coating thickness shall be 12 mils with a maximum tolerance of minus 2 mils.

Any pipe installed by directional drilling shall be coated with a sacrificial or abrasive top coat. The top coat is required to be minimum thickness of 0.030" (30 mils). Coating shall be factory applied unless approved by Engineer. This coating shall be from manufacturer's chart below.

Manufacturer	Base FBE	Abrasive Top Coat
Lilly Industries	2000	2040
3M Scotchkote	206N or 6233	6352
NapGuard	2500	2610
Power Lone Star		Powercrete

For field applied coatings and sleeve information see 14.06.04 & 14.06.05.

Exterior coating shall be cutback on pipe ends as follows:

For nominal sizes thru 12" - 2" cutbacks

Markings indicating the standard to which the pipe was manufactured shall be applied to the coated pipe.

Manufacturer, when requested, shall furnish ladle and check analysis of all heats used to make this pipe. For butt weld Class I pipe, supplier shall certify that the material furnished has been analyzed and meets the chemical requirements of API STD 5 L.

14.03.02 Steel Gas Main Pipe (3/4" and 1") and Fittings

Steel pipe in 3/4" and 1" diameter shall be black, standard weight, Schedule 40, conforming to the requirements of ASTM A106 or A53, and manufactured by a domestic supplier.

14.03.03 Polyethylene Pipe (1/2", 1", 2", 3", 4") and Fittings

Polyethylene pipe shall be made from Phillips TR-418, "Gulf" HD 9300-T, or Plexco P23BC resins (orange or yellow). Materials shall conform to ASTM D-2513, PE2708 or PE2406. Pipe and fittings shall conform to ASTM Specification D-2513 "Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings."

Pipe weights and thicknesses shall be as follows:

Size	OD	SDR No.	Minimum Wall Thickness	Lbs/Ft
1/2" CTS	0.625"	7	0.090"	0.06

1" CTS	1.125"	11.5	0.099"	0.14
1" CTS	1.125"	9.3*	0.121"	0.17
2" IPS	2.375"	11.0	0.216"	0.63
3" IPS	3.500"	11.5	0.304"	1.33
4" IPS	4.500"	11.5	0.391"	2.20

*SDR 9.3 pipe shall not be used for new installations.

Pipe shall be marked as shown in the current ASTM D-2513 standard; and in addition, the resin manufacturer's material designation shall be marked on the pipe. If any data marked on the pipe is coded, the supplier shall furnish the code key. Pipe shall be new or stored for a period of time that does not exceed the manufacturer's recommended maximum period of exposure, regardless of the method of storage. (192.321g)

Polyethylene fittings shall be the socket fusion type conforming to the current ASTM D-2683 Specification "Socket Polyethylene Fittings for SDR 11 Polyethylene Pipe, or Butt Fusion pipe conforming to the current ASTM D-3261 specification."

An electrofusion type coupling or saddle fitting shall be manufactured by Georg Fischer Central Plastics. Other electrofusion fittings may be substituted upon approval of the Engineer.

Polyethylene service tee fittings shall be saddle fusion type or electrofusion type by Georg Fischer Central Plastics or Engineer approved equal conforming to the current ASTM D-2513 standard.

Cutter punch size for 1" CTS service taps shall be 11/16" or larger.

Straight lengths of 2" or 3" pipe will only be permitted when specified or with approval of the Engineer, where it is determined to be most suitable for a particular installation.

Coiled pipe or tubing delivered to the work site shall have the ends capped.

Pipe Size	Minimum Coil ID	Maximum Coil OD	Maximum Coil Width
1/2"	30"	44"	6"
1"	44"	48"	12"
2"	48"	78"	41"
3"	70"	102"	44"
4"	70"	-	45"

Pipe strapping shall be made of plastic or other non-metal material. Coils shall have strapping around the interior portions of the coil to prevent partial coils from collapsing, as well as a sufficient number of straps around the completed coil. Polyethylene pipe and fitting shall be Driscopex, Continental, Dura-Line, or Phillips or approved equal.

14.03.04 Polyethylene Pipe (6" & 8") and Fittings

Polyethylene pipe shall be made from "Phillips TR-418" (orange or yellow), "Gulf HD 9300-T" (orange or yellow), or "Plexco P23BC" (orange or yellow) resins. Material shall conform to ASTM D-2513, PE2708 or PE2406. Pipe and fittings shall conform to ASTM Specification D-2513 "Standard Specification for Thermo-plastic Gas Pressure Pipe, Tubing and Fittings".

Pipe weights and thicknesses shall be as follows:

Size	OD	SDR No.	Minimum Wall Thickness	Lbs/Ft
6"	6.625 $\pm$.011	11.5	0.581"	4.7
8"	8.625 $\pm$.011	11.5	0.750"	7.99

Pipe shall be marked as shown in the current ASTM D-2513 standard, and, in addition, the resin manufacturer's material designation shall be marked on the pipe. If any data marked on the pipe is coded, the supplier shall furnish the code key. Pipe shall be new or stored for a period of time that does not exceed the manufacturer's recommended maximum period of exposure. Pipe older than the maximum period of exposure will still be accepted if the manufacturer or supplier submits written documentation that the pipe was stored inside under conditions not exposed to UV light. The written documentation must include the location where the pipe was stored and the corresponding dates it was stored there.

Polyethylene fittings shall be the butt fusion type conforming to the current ASTM D-3261 Specification "Butt Heat Fusion (PE) Plastic Fittings for (PE) Plastic Pipe and Fittings". Electrofusion fittings are an acceptable alternative.

Pipe shall be furnished in straight lengths. Length shall be in a minimum of 40 foot lengths. Straight lengths shall have plain ends without couplings unless otherwise specified.

Straight lengths of pipe shall be strapped with a sufficient number of non-metallic straps so the bundle will remain intact during shipping and warehousing.

Only with the Engineer's approval, pipe may be furnished by the contractor in coils. Contractor shall be responsible for the straightening of the pipe according to the manufacturer's instructions.

14.03.05 Polyethylene Pipe (8" and 12") and Fittings

Polyethylene pipe shall be Yellowstripe 8300 by Performance Pipe or equivalent by JM Eagle or Dura-Line. Other brands shall receive prior approval from the Chief Engineer.

Materials used for manufacture of polyethylene pipe shall be PE3408/PE4710-PE100 high density polyethylene. Pipe and fittings shall conform to ASTM Specification D2513 "Standard Specification for Thermo-plastic Gas Pressure Pipe, Tubing and Fittings".

Pipe weights and thicknesses shall be as follows:

Size	OD	SDR No.	Minimum Wall Thickness	Lbs/Ft
8"*	8.625 $\pm$.011	11.0	0.784"	8.49
12"	12.750 $\pm$.017	11.0**	1.159"	17.58

* All 8" HDPE Gas Main will be supplied by the Department and shall only be used where detailed in 8" to 12" pipe size transitions.

** 12" Gas Mains installed in 2014, 2015, and some from 2016 were installed as SDR 13.5 prior to the SDR 11.0 Standard.

Pipe shall be marked as shown in the current ASTM D-2513 standard, and, in addition, the resin manufacturer's material designation shall be marked on the pipe. If any data marked on the pipe is coded, the supplier shall furnish the code key. Pipe shall be new or stored for a period of time that does not exceed the manufacturer's recommended maximum period of exposure, regardless of the method of storage.

Polyethylene fittings shall be the butt fusion type conforming to the current ASTM D-3261 Specification "Butt Heat Fusion (PE) Plastic Fittings for (PE) Plastic Pipe and Fittings". Electrofusion fittings are an acceptable alternative.

Pipe shall be furnished in straight lengths. Length shall be in a minimum of 40 foot lengths. Straight lengths shall have plain ends without couplings unless otherwise specified.

Straight lengths of pipe shall be strapped with a sufficient number of non-metallic straps so the bundle will remain intact during shipping and warehousing.

Pipe shall be black with a minimum of 4 yellow stripes.

14.03.06 PTFE Hose

PTFE (polytetrafluoroethylene) hose shall have a PTFE bore with a braided stainless steel covering to provide adequate pressure rating and protect the core. Hose ends shall be threaded stainless steel. Hose shall have the following pressure ratings:

Size	Pressure Rating (PSI)
1/2"	1500
3/4"	1100
1"	750

1 1/2"	700
2"	525

14.04 Valves

14.04.01 Steel Gate Valves

Valve shall be a non-lubricating full port, steel body valve with a single disc which, when closing, results in a wedging action against the double seats, or compression of an elastomer against the seating area. Valve shall have a non-rising stainless steel stem, and the following features:

Pressure Rating:	285 WOG
Ends:	150# ANSI Flat or Raised Face Flanges (as specified)
Operator:	2" Square and open Counter-clockwise
Coating:	"Scotchkote" #306 resin - 9 mils min.

Each valve shall have attached label indicating brand name or manufacturer, model number, pressure rating, and standard by which it was manufactured, such as API #, MSS-SP#, ANSI#, etc.

Valve shall be manufactured by Kerotest and be Model EV-11. For throttling applications on bypass lines, valves shall be Kerotest Model M-1 Flanged End (1F2). Other valves may be used with the written approval of the Engineer.

When specified, locking devices (not including the lock) shall be provided by the valve manufacturer and shall consist of a two-part unit, a cap and a swivel nut which fits onto the stem and over the operating nut. Device shall be equal or similar to Kerotest's Model 1 Locking Device.

14.04.02 Steel Ball Valves

A. Steel Valves – Trunnion Mounted Ball Valves. Valves shall be non-lubricating with emergency sealant ports, full port, double block and bleed, steel body, non-rising carbon steel nickel plated stem and the following features:

Pressure rating:	ANSI 150,300,600
Ends:	150# ANSI flat or raised face flanges 300#, 600# ANSI raised face flanges
Operator:	2"-4" valves to be lever operated except when specified otherwise (2" square operating nut) 6" and larger valves to be gear operated with hand wheel except when specified otherwise (2" operating nut)

Coating: Below ground valves to be tar-set coated-30 mils thick.

Each valve shall have attached label indicating manufacturer, model & serial number, pressure rating and standard by which it was manufactured. Valves shall be Balon Series T, Broen Ballomax, Cameron Grove B4-D, B-5 or approved by the Engineer.

- B. Steel Valves – Floating Ball Valves. Valves shall be non-lubricating, full port, steel body, non-rising stem and the following features:

Pressure rating: 285 PSI
Ends: ANSI 150#-Flat face flanges (except when specified otherwise)
Operator: 2"-6" to be lever operated with locking plate (open or close)
8" and larger to be gear box operated

Each valve shall have attached label indicating manufacturer, model number, pressure rating. Valve shall be Balon series "F", Broen Ballomax, Kerotest Weldball, or approved by the Engineer.

Balon series "F" valves are approved for standard 2" meter stop valve applications.

14.04.03 Polyethylene Valves

Valves shall be Polyvalve (formerly known as Nordstrom Polyvalve), Polyball by Kerotest, Polytec by Lyall, Elster Perfection Corporation, Ballomax by Broen or approved equal. Valves up to 8" shall have a PE2406/2708 (orange or yellow) polyethylene body conforming to the following requirements. 12" valves shall have a PE4710 (black) polyethylene body conforming to the following requirements. 8" valves may be supplied with a PE4710 body and factory installed MDPE pipe pups.

Valves shall NOT be supplied with bypass lines.

All valves shall be ported as specified below unless approved otherwise by the Chief Engineer of Utilities. Valve ends shall be sufficiently long to fit into fusion machines for butt fusion to SDR 11.5 (4-inch, 6-inch and 8-inch) and SDR 11.0 (12-inch) pipe. Valve operators shall be as specified.

Size	Bore/Port	SDR	Connection End Min. Length	Operator
1" CTS	Full port	9.3 / 11.5	Socket Type	Slotted
2" IPS	Full port	11.0	Socket Type	2" Square nut
3" IPS	Full port	11.5	Socket Type	2" Square nut

4" IPS	3.50" diameter	11.5	Min. 7" long	2" Square nut
6" IPS	4.75" diameter	11.5	Min. 7" long	2" Square nut
8" IPS	6.60" diameter	11.5	Min. 5" long	2" Square nut
12" IPS	10.10" diameter	11.0	Min. 3.5" long*	Gear Reducing with 2" Square nut

- * For 12" valves purchased directly by the City for installation by the City, a minimum 30" pup shall be factory installed on each side of the valve to allow it to fit in current City-owned fusing equipment. Pup length for Contractor purchased valves shall be determined by the Contractor.

Each valve shall be clearly marked or labeled to show: the standard such as B16.40 to which it was manufactured; the manufacturer's name or trademark; the size; the pressure rating; SDR number and material standard, i.e. PE2306, 2406, 4710 of connecting end material.

14.04.04 Excess Flow Valves

Excess flow valves shall meet or exceed all requirements of CFR Title 49 Part 192.381, ASTM F 2138, and MSS-115.

Excess flow valves used on gas services that operate continuously throughout the year at a pressure not less than 10 psig shall be manufactured and tested by the manufacturer according to an industry specification, or the manufacturer's written specification, to ensure that each valve will comply with the following performance standards:

- A. Function properly up to maximum operating pressure at which the valve is rated;
- B. Function properly at all temperatures reasonably expected in the operating environment of the service line;
- C. At 10 psig:
 - 1. Close at, or not more than, 50 percent above the rated closure flow rate specified by the manufacturer; and
 - 2. Upon closure, reduce the gas flow as follows:
 - a) For an excess flow valve designed to allow pressure to equalize across the valve, to no more than 5 percent of the manufacturer's specified closure flow rate, up to a maximum of 20 cubic feet per hour; or
 - b) For an excess flow valve designed to prevent equalization of pressure across the valve, to no more than 0.4 cubic feet per hour;

- D. Not close when the pressure is less than the manufacturer's minimum specified operating pressure and the flow rate is below the manufacturer's minimum specified closure flow rate.

Excess flow valves shall be LYCO EFV by R.W. Lyall for 1/2" CTS (0.090" wall thickness) or 1" CTS (0.099" wall thickness) unless specified otherwise by the Chief Engineer of Utilities. The series used on each service shall be determined by Engineering.

14.04.05 Meter Stop Valves (3/4" and 1" sizes)

Meter stop valves shall be 175 psi, black iron body, brass or bronze key, stem nut and stem washer, tamperproof, lubricating type, lockwing with 1/2" hole. Inlet and outlet to have iron pipe inside threads. Outlet to have insulated union. Valves shall be A.Y. McDonald 6276B, Mueller H-11179, or an approved equal.

14.04.06 Plug Valves

Plug valves shall be rated for minimum WOG 175, with high strength cast iron body conforming to ASTM A 126-42, Class B. Valve shall have a lubricating fitting centered on top of the stem where lubricant will travel through the stem, a double ball check, and to sealant grooves to the well at the base of the plug.

Valves shall be short pattern with 125# ANSI flanges and have a 2-inch square operating nut. Valve shall be Walworth 1797F, Nordstrom 143, Homestead 602 or 612, or an approved equal.

14.04.07 Meter Stop Valves for Multiple Meters

Meter stop valves shall be 175 psi, black iron body, brass or bronze key, stem nut and stem washer, tamperproof, lubricating type, lockwing with 1/2" hole. Inlet and outlet to have iron pipe inside threads. Valves shall be A. Y. McDonald 6276B, Mueller H-11179, or an approved equal.

14.04.08 Miscellaneous Transmission Main Ball Valves

These valves are located at the Pig Launch, Pig Receiver, and GL Regulator Station, 1/2", 3/4", and 1". The design of the ball valve shall meet or exceed all requirements of ASME B16.34, MSS SP-110, and the end connections shall meet or exceed all requirements of ASME B1.20.1. The ball valves shall be either 3000# WOG black iron body type or 1000# WOG Stainless Steel, Grade CF8M/316SS, threaded NPT end, full port, two piece manufactured by FNW, model Figure 200A.

14.05 Miscellaneous Fittings and Materials

14.05.01 Locating Wire, Connectors and Locating Boxes

Locating (tracer) wire shall be #12 solid copper with "HMWPE" 30 mil yellow insulation. Wire shall be supplied on spools of not less than 500 feet. If main and locate wire are to be placed by horizontal directionally drilling, tracer wire shall be #6 hard drawn copper (ASTM B-1) or annealed 49-strand braided 304 alloy stainless steel. The conductors shall be insulated with 45 mil yellow high-density polyethylene (HDPE) jacketing. The wire shall be tested in accordance with ASTM B-1 and D-1248 and spark tested at 7500 VAC. The breaking strength of the wire shall be at least 1260 pounds or approved equal.

Splices in the copper tracer wire should be made with solder, split bolt type connectors or other type approved by the Engineer. Splices in the stainless steel tracer wire should be made with split bolt type connectors or other type approved by the Engineer. Wire nuts or clip type connectors shall not be used. All connections shall be protected to make them watertight. Waterproofing material shall be 3M 2200 pads or equal.

Locating Boxes shall be Snake Pit's magnetized tracer boxes from Copperhead Industries, LLC, (or approved equal) as follows:

Color	Installation Type	Model
Yellow	Turf	Snake Pit Lite Duty Box Model LD14YTP
Yellow	Bituminous	Snake Pit Roadway Box Model RB14YTP
Yellow	Concrete	Snake Pit Concrete/Driveway Box Model CD14YTP

The tracer box shall have a yellow powder-coated cast iron cover for natural gas.

All tracer box covers shall have insulated brass connecting lug for direct connection hook-up for a locator transmitter.

All tracer box covers shall have an alpha character stamped on top of the pentagon security bolt. Character shall be "G" for natural gas.

The Contractor may also use Snake Pit Style boxes with an adjustable top as an acceptable equal for turf installations only. All other substitutions must be approved by the City prior to bidding.

14.05.02 Service Riser (3" and larger services)

All 3" and larger risers shall be fabricated and provided by the Department. Riser shall be welded steel to a below grade depth of 18" minimum, then transition to PE pipe with a 90 bend at 36" minimum bury depth. The risers shall have a 150# flange on top and provisions made for anode attachment. Cathodic protection shall be provided per soil to air interface requirements as specified in Section 14.06.05. Steel pipe shall be in conformance to ASTM A106, ASTM 53, or API 5L, all Grade B.

Risers 3" in size may also be anodeless angle type with Phillips TR-418 plastic carrier pipe encased in a galvanized or a fusion bonded epoxy coated metal casing. Vertical rise shall be 30 inches of which the top 15 inches shall be centered in the casing so that air or a heat resistant material occupies the space between. Carrier pipe to casing shall be sealed in the upper end by means of insert stiffener and compressed O-Rings or rubber seals. Horizontal leg shall be steel casing a minimum of 12 inches and a maximum of 20 inches plus a 12" pigtail of plastic pipe not encased. Below grade, end of casing shall be effectively sealed against water intrusion. The 3" anodeless riser may be installed in a 66 PSI system and shall have a carrier pipe wall of 0.304" and a top connection of 3" 150# welded flange. Riser shall be one of or an approved equal to Georg Fischer Central Plastics, Perfection, Dresser, or R W Lyall and Company.

14.05.03 Service Risers (1/2" CTS x 3/4" IPS and 1" CTS x 1" IPS and 2" IPS)

Riser shall be anodeless angle type with PE 2406 or 2708 plastic carrier pipe encased in a galvanized or a fusion bonded epoxy coated metal casing.

Vertical rise shall be 30 inches of which the top 15 inches shall be centered in the casing so that air or a heat resistant material occupies the space between. Carrier pipe to casing shall be sealed in the upper end by means of insert stiffener and compressed O-Rings or rubber seals. Horizontal leg shall be steel casing a minimum of 12 inches and a maximum of 30 inches plus a 12" pigtail of plastic pipe not encased. Below grade, end of casing shall be effectively sealed against water intrusion. The 2" anodeless riser may be installed in a 66 PSI system.

An approved alternate service riser for 1/2" CTS x 3/4" IPS and 1" CTS x 1" IPS is a Georg Fischer Central Plastics anodeless flex service riser, Lyco flexible service riser by R.W. Lyall, Elster Perfection flexible riser, or an approved equal. Riser shall be anodeless angle type with PE 2406 or 2708 plastic carrier pipe encased in a galvanized or a fusion bonded epoxy coated metal casing and sunlight resistant flex tubing. Vertical rise shall be 30 inches of which the top 18 inches shall be centered in the casing so that air or a heat resistant material occupies the space between. Carrier pipe to casing shall be sealed in the upper end by means of insert stiffener and compressed O-Rings or rubber seals. Horizontal leg shall be sunlight resistant flex tubing a minimum of 24 inches long plus a 12" pigtail of plastic pipe not encased. Below grade, end of casing shall be effectively sealed against water intrusion.

	1/2 CTS x 3/4 IPS	1" CTS x 1" IPS	2" IPS
Carrier Pipe Wall	0.090"	0.099"	0.216"
Top Connection	3/4" IP outside	1" IP outside	2" I.P. threads

14.05.04 Transition Fittings (PE to Steel)

Transitions shall be resin coated Schedule 40 steel pipe connected to the polyethylene pipe with a factory-made permanent type compression joint meeting the requirements of ASTM D-2513 and ANSI B-31.8. Steel end shall be for weld type connection. Plastic portion shall conform to the minimum requirements for PE pipe as indicated below.

Size	Wall	Material	Type of Connection
1" CTS	SDR 11.5	PE 2406 or 2708	Steel Socket
2" IPS	SDR 11.0	PE 2406 or 2708	Steel Socket
3" IPS	SDR 11.5	PE 2406 or 2708	Steel Socket
4" IPS	SDR 11.5	PE 2406 or 2708	Butt
6" IPS	SDR 11.5	PE 2406 or 2708	Butt
8" IPS	SDR 11.5	PE 2406 or 2708	Butt
12" IPS	SDR 11.0	PE 4710	Butt

14.05.05 Valve Box

Box shall be two section, screw type with a cast iron top section and a plastic bottom section with a 5-1/4-inch ID, threaded shaft integral with a 9-inch diameter bonnet or bell. Heights of the sections shall be selected to fit the installation depth when the base is over the operating nut, but not closer than 2 inches to the valve flange. Plastic may be sawed off as required. Refer to Detail Drawing G-5 in the Appendix.

Valve boxes for valves with gear box operators shall be constructed as detailed in the Standard Construction drawings.

Cover shall be the stay-put type cast iron having 2 recessed lift holes. The identification "GAS" shall be cast into the cover.

Valve boxes shall be manufactured by Bingham and Taylor 500 series, High Line Products, or approved equal.

14.05.06 Casing Seals

For PE carrier pipe, casing seals shall be the pull-on "S" or "U" type made of oil and water resistant rubber, complete with stainless steel thumb screw clamps. Casing seals shall be P.S.I., Type S, F.H. Maloney Multiflex, T.D. Williamson U-Seal, or approved equal.

For steel carrier pipe, casing seal shall be link seal type similar or equal to Link-Seal manufactured by GPT or approved equal.

14.05.07 Strainers

Strainers shall be self-cleaning "Y" type, ductile iron or cast-steel body-125# ASA rating with screwed ends for up to 2-inch sizes and 150# ANSI raised face flanged ends for

sizes 2-inch and larger. Screen shall be monel or stainless steel wire, 30 mesh, with openings 1/50". Effective screen ratio shall be at least 2:1 or greater. Screen access cover shall be tapped FI PT for blowoff. Strainers shall be manufactured by Mueller, Fabrotech, or Keckley.

Strainers for large regulator stations having flow metering shall be equipped with 100 mesh screens accessible through a removable flange. Manufacturer shall be Fabrotech Industries or approved equal.

Strainer for transmission line use is a 6" or larger simplex basket style with 600# ANSI flanges and body, 100 mesh liner.

14.05.08 Bolt-Type Couplings (no longer used)

Use was discontinued by or before 1993. Couplings no longer used on gas systems include Dresser Style 39-62, Style 38, Style 40, Style 711 and CS1 CLa Maxi-Grip.

14.05.09 Steel Weld Flanges

Flanges shall be either welding neck or slip-on, flat face unless specified otherwise, 150# or 300# ANSI B16.5, and conforming to the ASTM Specification A181, except for transmission which are 600# ANSI, raised face.

14.05.10 Gaskets

Gaskets for Flanged Connections shall be PSI Linebacker Sealing gasket with G-10 core and nitrile sealing element. Transmission line gaskets shall be 600# Flexitallic, PSI Linebacker Sealing gasket with G-10 retainer and Teflon or Viton sealing element or approved equal.

14.05.11 Bolts

Bolts for flanged connections shall be ASTM449 medium carbon steel, SAE Grade 5, medium carbon quenched-tempered and the head marked with a "Y" to indicate grade. B7 stud is an acceptable alternative when bolts do not fit the application. Bolts for transmissions will be ASTM A320 L7 grade, 600# ANSI.

BOLT INFORMATION FOR FLANGED CONNECTIONS (150# CLASS)

Size	Flange OD Inches	No of Bolts Per Flange	Diameter of Bolts*	Bolt Length*	Stud Length	Suggested Torque Ft-Lbs **
2"	4-1/8"	4	5/8"	2-1/2"	3-1/2"	80
3"	5-3/8"	4	5/8"	3-0"	3-3/4"	110
4"	6-7/8"	8	5/8"	3-0"	3-3/4"	100
6"	8-3/4"	8	3/4"	3-1/4"	4-1/4"	130

8"	11"	8	3/4"	3-1/2"	4-1/2"	130
10"	13-3/8"	12	7/8"	3-3/4"	4-3/4"	215
12"	16-1/8"	12	7/8"	3-3/4"	5-0"	220
16"	20-1/4"	16	1"	4-1/4"	5-1/2"	320

Notes:

1. Bolt or stud length for Insulating Flanges shall be 1/2" longer than length shown in chart.
2. Bolt or stud shall have a minimum of two (2) exposed threads on the nut end.
3. Torque is based on lubricated bolt and bolt stress of 45 ksi.

On Transmission system, Engineering must be contacted prior to work for approval of diameters, length, number, and recommended torque.

14.05.12 Amp-Fit Couplings (no longer used)

Amp-Fit Transition Couplings (1/2" CTS PE to 5/8" OD Copper). Fitting was designed to connect 1/2" CTS - .09" wall polyethylene to 5/8" OD - Type K Copper. Fitting was Amp-Fit Part No. 332643-1.

Amp-Fit Repair Coupling (1/2" CTS, 1" CTS, 2" IPS - PE to PE). Fitting was designed to connect the following polyethylene pipe sizes:

- 1/2" CTS PE - .09" wall - SDR 7 - Part No. 332629-2
- 1" CTS PE - .121" wall - SDR 9.3 - Part No. 561414-1
- 2" IPS PE - .216" wall - SDR 11 - Part No. 561124-2

14.05.13 Mechanical Plastic Pipe (1/2") Coupling, End Caps, and Cap-N-Go Couplings

Coupling shall have a plastic body with plastic end sleeves designed to compress the pipe over plastic barbed ends with a metal stiffener that extend the length of the coupling or couplings shall have a plastic body with two internal seals, a fixed stiffener, self-locking gripper and a moisture lip. Couplings and end caps shall be tested to conform to ASTM D2513. Coupling and end caps shall be labeled to indicate a pipe size and wall thickness as follows:

1/2" CTS - 0.09" Wall - SDR 7

Coupling shall be Continental Con-Stab ID Seal Full Coupling.

Mechanical End Caps and Cap-N-Go fittings should only be used for temporary disconnections and shall not be used for capping permanently removed segments.

14.05.14 Electrofusion Plastic Pipe Coupling (1", 2", 3", 4", 6", 8", 12")

Couplings shall be compatible with an approved electrofusion unit. Electrofuse coupling shall be Lycofuse, Integrity or Central Plastics. Couplings for medium density pipe shall

be PE2406/2708 or PE4710 (orange, yellow, tan or black). Couplings for high density pipe shall be PE4710 (black only).

14.05.15 Service Tees for 3-inch & Smaller PE Services on Steel Mains

Service tee shall be steel, designed for at least 100 psi working pressure with a weld-on inlet end, incorporate an internally-contained tap, and have an outlet designed to connect polyethylene pipe, PE2406/2708. The connection to the polyethylene pipe shall be designed so that the pullout resistance exceeds the strength of the pipe in accordance with D.O.T. Pipeline Safety Regulations, Part 192.283(b). An insert stiffener shall be attached to each compression end.

Service Tee for 1/2-inch and 1-inch services shall be equal or similar to the table below:

Compression Outlet	Weld Inlet	Tap Size	Model
1/2" CTS PE, 0.090" Wall	3/4-inch	3/8-inch 3/8-inch	Mueller 18702 Mueller 18104
1/2" CTS PE, 0.090" Wall *	1/2-inch	3/8-inch 5/16-inch	Mueller 18198 Mueller 18104
1" CTS PE, 0.090" Wall	3/4-inch	1/2-inch 3/8-inch	Dresser 501 Mueller 18104

* For connection on steel mains sizes 2-inch and smaller.

Service Tee for 2-inch and 3-inch services shall be equal or similar to the table below:

Weld Outlet	Weld Inlet	Tap Size	Model
2-inch	2-inch	1-1/2 inch	Mueller H-17650

14.05.16 Steel Extrude or Copper to P.E. Coupling - 5/8" OD (no longer used)

Coupling shall be designed to connect either 5/8" OD steel or copper tube to 1/2" (5/8" OD) - 0.090" wall or SDR7 polyethylene tube. Coupling shall be brass or bronze and have a built-in stiffener in one end. The connecting ends must be designed so that the P.E. pipe will fail before the pipes could be pulled out of either end of fitting.

Markings on coupling shall show manufacturer, OD of connecting pipes, and wall thickness for P.E. connection.

Coupling shall be Chicago fitting, Part No. M785DC23S090 or approved equal.

14.05.17 Rock Shield

Rock shield shall be Liberty HD Rockshield, Tuff-N-Nuff Rockshield, or similar product approved by the Chief Engineer. Rock shield shall be 3/8" thick and made of random

yellow looped resilient non-woven web mat manufactured using flexible, lead free, PVC material. The PVC material shall consist of small diameter (0.031" to 0.036") strands bonded non-directionally to each other.

Rock shield shall be double wrapped around the pipe.

14.05.18 Weather Caps

Weather caps shall be a non-toxic blend of PVC, plasticizer and ultraviolet inhibitors designed to seal out rain, ice, snow, sand, salt spray, insects, and birds. Weather caps shall remove with minimal backpressure.

14.05.19 Pipe Thread Sealants

Acceptable pipe thread sealants are Gasoila Soft Set with PTFE (preferred), Megaloc, Teflon tape, or approved equal. If anti-seize is utilized, it shall be Permatex 80078 Anti-Seize lubricants.

14.05.20 Mechanical Pressure Gauges

Mechanical Pressure Gauges shall be 2 ½" diameter, silicone or glycol filled, stainless steel case and base, and spiral tube with a polycarbonate lens. Piping connection shall be ¼" NPT male pipe connection and must be installed downstream of an isolation valve. Gauge shall display units in PSI from 0 to 120 or 160 and shall have intermediate increments of 2 PSI.

14.05.21 Pipe Supports

Acceptable pipe supports shall be manufactured by E-Z Line Pipe Support Co. or approved equal. Pipe supports shall have a nylon or neoprene shoe that contacts the supported pipe, all other materials shall be hot-dip galvanized steel. The pipe support collar shall have an adjustable height with a threaded column and securing nuts. Typically, the support will be supplied with a base plate containing slotted holes for anchoring to a floor or concrete support column.

14.05.22 Closed Cell Polyurethane Foam

Closed cell foam shall be Touch'n Seal 1.75 PCF polyurethane spray foam or equal. Open cell foams are not allowed.

14.05.23 Alcohol for Pipe Cleaning

Alcohol used for pipe cleaning prior to fusion shall be minimum 96% isopropyl alcohol. Alcohol containers shall be properly labeled to meet SDS standards.

14.05.24 Below Grade Tap Tee and Fitting Utility Markers

Below Grade Utility Markers shall be constructed of polyethylene, designed to fit over, zip-tied, or adhered to a pipeline, fitting, or tap-tee cap. The marker will be equipped with a 24" tall, utility color coded, vertical identifier that contains a locate-able magnet. The vertical identifier may include an adhesive flag with customizable message. Below Grade Utility Markers shall be Tee'd Up Markers by Cumberland Products or approved equal.

14.06 Cathodic Protection Materials**14.06.01 Anodes**

Anodes for gas main and structure protection shall be the packaged type consisting of a cast magnesium anode having a silver soldered #12 TW lead wire at least 10 feet long attached to a steel core. Anode shall be encased with cloth bag containing a prepared backfill mixture of: hydrated gypsum, bentonite, and sodium sulphate. Weight of magnesium anode shall be 17 lbs. minimum or as specified for pipeline cathodic purposes.

Anodes, when specified to protect service risers or isolated fittings, shall be magnesium weighing at least one pound with at least 5 feet copper THNN wire. Anode shall be effectively attached to the protected material with a stainless steel base clamp.

Magnesium anodes for tracer wire applications shall be 1 lb. minimum.

Anodes shall be similar or equal to Galvomag by Harco or Maxmag by Federal Metals.

14.06.02 Test Terminal Box

Grade mounted box for use in nonpaved locations shall be ABS or PVC plastic, at least 17 inches long with slight flare at the base. Inside diameter shall be at least 2-3/8 inches. Cap shall be of the same material as the box with a rim which extends over the top of the box to prevent entry of foreign materials. Cap shall lock by a wedging action when the center steel bolt is turned. Bolt shall be magnetic for easy locating. Attached to the inside of cap shall be a 5 bolt terminal block which will bring the wires out of the box with the cap. Cap shall be impressed with the letters "TEST STATION". Box shall be "Handley Industries" Model TP-5B, "Flush Fink" by Cott Industries, or an approved equal.

Free standing test stations/markers shall be "Rhino TriView Post" test stations or an approved equal.

Pole mounted test stations shall be Crouse-Hines conduit E-27 with 3/4" threaded outlet attached to a minimum 24 inches of 3/4" galvanized conduit with plastic end protector or approved equal.

Face plate shall be Crouse-Hines No. 2770, terminal plate supplied with No. E type of terminal connection or approved equal. The grade mounted, pole mounted, and free standing test stations to be supplied by Public Works & Utilities Department, Utility Operations, 520 Garfield Avenue, unless otherwise specified.

14.06.03 Insulators

Flange insulators for ANSI 150# through 300# full face flanges shall be phenolic retainers with nitrile sealing elements, complete with full length Mylar sleeves and glass clad phenolic washers for insulating bolts on one side of flange. Flange insulators for ANSI 600# full face flanges shall be G-10 retainers with Teflon or Viton sealing elements, complete with full length G-10 sleeves and G-10 washers for insulating bolts on one side of flange. Gasket shall be Type E faced, 1/8-inch thick, for ANSI 150# through 600# full face flanges, as manufactured by Pipe Seal and Insulator Company (PSI), Central Plastics Company, or an approved equal.

Casing insulators shall be two or more segments of molded polyethylene bolted together so the segments fit tightly around the carrier pipe. Insulator shall be "Pipeline Seal and Insulator" Model PE, F H Mahoney Pipeline Products, Model 60, or T D Williamson, Inc., Model N-2, or approved equal.

Pipe support insulators shall be molded fiberglass shaped to conform to fit over specified pipe sizes, one or two pieces as specified, complete with epoxy seam sealer which fills all voids between pipe and insulator. Pipe support insulators shall be similar or equal to "Glas Mesh Type 180, Type 240, or Type 220/240.

Pipeline insulators for electrically isolating sections of steel gas lines shall be one-piece weld end spools, fabricated with API 5L Grade B Steel, rated for ANSI 150# or 300#, coated internally and externally with epoxy resin coating except for weld end cutbacks. Dielectric materials shall be compatible with natural gas.

Size (OD)	Wall Thickness	Size (OD)	Minimum Wall Thickness
4.500"	0.188"	10.75"	0.219"
6.625"	0.188"	12.75"	0.250"
8.625"	0.188"	16.00"	0.250"

Pipeline insulators shall be "IsoJoint" by Advance Products & Systems, Inc.; "PSI Electro-Stop Isolators" by Pipeline Seal & Insulator Inc.; Kerotest "Zunt" Type 1-A, or pre-approved equal.

14.06.04 Field Coatings (Below Grade)

See Section 25.05 for appropriate application.

A. Cold Type Applications. Cold applied coatings shall be one of the following approved commercial types or approved equals:

- Polyken 930-35 mill tape with #927 brush primer or #935 spray primer
- Tapecoat H-35G mill tape
- Scotchkote Corrosion Protection Tape #50 with Scotchrap pipe primer
- Royston Greenline Tape with 747 Primer
- T C Mastic (common hand applied bitumastic)
- Wax Tape by Trenton Corporation or approved equal for irregular fittings
- Scotchkote Liquid Epoxy Coating 323 or 328
- Denso Protal 7125 (brush on applications)
- Alternative fusion bonded epoxies only by Engineering approval.

B. Hot Type Applications. Hot applied coatings shall be one of the following tape-prime combinations or approved equal:

- Tapecoat 20 with T C Omniprime
- Thermofit (shrink) pipe sleeves by Raychem (Ultratec Division) or T C Omniprime
- Holidays less than two square inches in the epoxy pipe coating may be repaired using hot melt patch sticks, Scotchkote 226P or equivalent.

C. Directional boring pipe (shrink) sleeves shall be Dirax (by Raychem).

14.06.05 Field Coatings (Above Grade)

See Section 25.06 for appropriate application.

A. Rust-O-Leum Primer #678 or 769, Rustex, Derusto, shall be used when specified in Section 15.08(F). Color shall be gray unless otherwise specified.

B. Polyamide epoxy, high build, two part, one coat, similar or equal to Pittsburgh "Pit Guard" DTR or Rust-O-Leum High Performance Epoxy 9100V shall be used when specified. Polyamide epoxy in color white shall be applied to irregular fittings when tape coating is not practical. Color shall be gray unless otherwise specified.

C. Acrylic Urethane enamel with a compatible primer similar or equal to Pitthane Acrylic Urethane enamel with Medalhite 1001 inorganic zinc rich primer, or Aquapon Polymide-epoxy organic primer shall be used when specified. Color shall be gray

unless otherwise specified. An approved equal is Devthane 379 Top Coat with Devoe Bar Rust 235. Primer shall be Devoe.

- D. Tape coating, when specified for above grade applications, shall be similar or equal to Tapecoat H35 grey. Tapecoat H50 grey shall be used where abrasion from street grit is evident. System shall be resistant to ultraviolet light, shrinkage, ambient temperature changes.
- E. Soil to air interfaces shall be coated with Polyken 930-35 mill tape with #927 brush primer or #935 spray primer, Tapecoat H-35G mill tape, or Scotchkote Liquid Epoxy 323. Above grade the pipe shall be double wrapped with rock shield.

SECTION 15: GENERAL CONSTRUCTION REQUIREMENTS FOR HP GAS PIPELINES

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SECTION 15: GENERAL CONSTRUCTION REQUIREMENTS FOR HP GAS PIPELINES

15.01 General

This section of the Standard Specifications establishes requirements and policies for the installation of high pressure gas distribution systems operating at pressures ranging from 1 psig to 275 psig and a transmission line which operates at a pressure ranging from 550 psig to 974 psig. Low pressure gas mains and services, the remaining systems of which were abandoned in 1992, are only specified to the extent of involvement with high pressure construction, such as conflicts in location, abandonments, etc.

All excavation, backfilling and restoration and horizontal direction drilling required for the construction of high pressure gas distribution systems shall be performed in accordance with the City of Duluth, Minnesota Public Works & Utilities Department – Engineering Division, Standard Construction Specifications, most current edition.

For contracted projects, these specifications also establish responsibilities between the Contractor and the Department for providing labor and equipment for installations. The Plans and Special Provisions may change these responsibilities for particular projects; therefore, it is essential that those parts of the documents be carefully reviewed for each project, since they take precedence over this Standard Specification.

15.02 Excavation and Backfill Standards

Requirements for site clearing, excavation, preparing trench, backfilling, compaction and restoration are contained in the City of Duluth Public Works and Utilities Department – Engineering Division Standard Construction Specifications book, most current edition, and any addendums or supplements, and shall govern the execution of work where they are not in conflict with more specific requirements contained in the Plans, the Special Provisions, or in this section.

15.03 Clearance Requirements (192.325)

- A. Clearance requirements between underground gas mains and non-associated mains, utilities, structures, or rock shall be maintained at least as follows:

General Clearance -	6" - for rock, non-metallic pipe, structures, etc.
Special Clearances -	12" - for metallic pipe, structures, electrical conductor wires, etc.
	30" - between plastic gas pipe and steam lines
	12" - between plastic gas pipe and HDPE jacketed hot water lines

SECTION 15: GENERAL CONSTRUCTION REQUIREMENTS FOR HP GAS PIPELINES

Where these clearances cannot be maintained, the Contractor shall notify the Engineer, who will determine the method or materials required to protect the gas main.

B. Preventing Sewer Service Lateral Cross Bores

Acceptable installation practices and documentation requirements when installing gas mains and services shall be as follows. Gas pipelines must be installed using one or more of the following methods. Every individual sewer service lateral must be protected by use of one of these methods. Each description below includes documentation requirements.

1. Open Trench Method

The open trench must extend the full width of the property or the full length of the installation. Document all addresses/locations where the installation was performed by open trench.

2. Map and Record Method (Trenchless)

Maps and records of sewer service laterals may be used to demonstrate that no conflict between the gas pipeline and the sewer service lateral is possible. For example, if the gas service enters the front of a structure and the sewer service exits the back of the same structure, the two utilities will not cross. The excavator's complete confidence in sewer service lateral maps is essential. Document the criteria by which the lack of conflict was established and all addresses/locations where this method was used.

3. Exposed Sewer Method (Trenchless)

Pothole and expose the sewer service lateral at the gas crossing; the cutting head must be visible in the pothole. Document the distance between the drilling head and the sewer service lateral at all addresses/locations where this method was used. Photographic documentation showing both the drilling head and the sewer lateral is optional, but recommended.

4. Sonde Method (Trenchless)

Sewer service lateral location and depth may be determined by a sonde transmitter at the crossed location. If this method is used, the drilling head must be equipped with a sonde, and must be at least three feet from the sewer service lateral. Each sonde must be calibrated daily. Document the sewer service lateral depth and the drilling head depth at each crossed location along with all addresses/locations where this method was used.

5. Relative Elevation Method (Trenchless)

The highest elevation of an individual sewer service lateral may be determined by entering the structure and verifying the sewer drain's elevation as it leaves the

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structure. The drilling head must be equipped with a sonde, and the drill must at all times be at least three feet above the highest sewer service lateral elevation. The three-foot separation must be maintained across the entire width of the property. The sonde must be calibrated daily. Document the highest sewer service lateral elevation relative to the drilling head elevation along with all addresses/locations where this method was used.

6. Televising Method (Trenchless)

Individual sewer service laterals may be televised after the gas pipe has been installed. No gas may be introduced into the new pipeline until the sewer service lateral has been televised. Document with an electronic, visual record of the televising along with a written report. Correlate the sewer lateral connection (wye) location with the street address in written report. Use of this method does not alleviate the excavator's responsibility to obtain all available information regarding the location of sewer service laterals prior to installation of a gas pipeline (maps, drawings, diagrams or other records). Upon request, excavator should be prepared to produce such information at the job site. The Contractor shall coordinate televising with the property owner. Televising must extend from the structure all the way to the sanitary sewer main.

7. Other Trenchless Sewer Service Lateral Verification Methods

With prior approval from the Engineer, other gas pipeline installation methods that demonstrate and document protection of sewer service laterals may be used.

In all methods, documentation must be retained for the life of the pipeline.

These methods do not replace the need to mark and locate sewer service laterals prior to construction.

After installation of new gas pipeline by methods 3 through 7, gas pipeline installers should report to the local sewer operators the verified locations of individual sewer service laterals. These verifications improve location records of sewer operators.

Unacceptable Practices:

1. Listening devices may be used to supplement acceptable practices, but must not be used in lieu of them. Because there is no positive visual verification and no way to accurately document the results, the use of listening devices alone is unacceptable.
2. Any procedure that does not allow for positive documentation of cross bore prevention is unacceptable.

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C. Required Procedures to Maintain Clearances When Moling or Horizontal Directional Drilling across Sewers**Sanitary Main, Storm Main, or Storm Inlet Lead**

Remove nearest manhole lid and measure depth to sewer. If the proposed crossing is within 50' to manhole, then inspection of only one manhole is adequate. If the manhole is further than 50' away, the manhole at the other end shall also be inspected.

If sewer is greater than 7' deep, no additional precautions are necessary.

If sewer is between 4.5' to 7' deep, keep track of mole or drill distance. If possible, visually check inside pipe to ensure no damage. After crossing sewer, perform a video inspection.

If sewer is less than 4.5' deep, excavate in street over sewer and mole or drill each way.

15.04 Alignments for mains

Alignments for mains shall be as indicated on the Plans. The Department will establish exact alignment prior to construction, and reserves the right to make minor changes as work progresses at no additional compensation. Major changes may be considered for extra payment only to the extent where: They are major deviations from Plan alignment; the Contractor informs the Department and obtains a written understanding for the basis of payment for extra work prior to construction of that portion. Fittings necessary to fit the Plan, whether indicated on the Plan or not, shall be considered incidental to the pipeline.

15.05 Grade for mains and services (192.327)

Grade shall be established by the depth of cover, except where indicated on the Plans or specifically established by the Engineer.

Table 15-1 Minimum and Maximum Depth of Cover		
Type	Minimum Cover (inches)	Maximum Cover (inches)
Transmission Main	48	72
Main – general	36	48
Main – rock trench	24	48
Service – less than 2"	18	48
Service – 2" and larger	36	48

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Service – under driving surface	36	48
Service – rock trench	12	48

When these depths cannot be maintained, the Contractor shall notify the Engineer, who will determine the method or material required to protect the main.

15.06 Backfill for trenches

All excavation, backfilling and restoration and horizontal direction drilling required for the construction of high pressure gas distribution systems shall be performed in accordance with the City of Duluth, Minnesota Public Works & Utilities Department – Engineering Division, Standard Construction Specifications, most current edition and any supplements or addenda.

For gas mains and services installed under the following conditions:

- A. Under a driving surface, including graveled shoulders, driveway, parking lots
- B. Under a sidewalk
- C. To provide a base for undercut foreign utilities, curbs, walks, etc.

Class 5 granular material conforming to MnDOT 31328 shall be used.

15.07 Certification of Welders and Fusers

All pipeline welding shall be done by qualified Welders in accordance with Section 27 of these Standards.

All pipeline fusing shall be done by qualified fusers in accordance with Section 28 of these Standards.

15.08 Load Considerations

Special protection shall be provided to avoid direct extraordinary loads or external forces on the pipe. The Engineer will determine if and what kind of special protection shall be provided. A pipeline must be designed and installed so that each joint will sustain longitudinal pullout or thrust forces caused by the contraction or the expansion of the piping or by anticipated external and internal loading.

15.09 Installation of Protective Barriers

The Department or Contractor, when specified, shall install protective barriers to protect gas pipeline facilities from traffic or other hazards.

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When above grade gas mains, service risers, regulators, or meter sets meet one of the following conditions, pipe bollards shall be installed in accordance with Detail Drawing G-33:

- A. Where the edge of the travel lane is within 10 feet of a pipeline or meter
- B. Where a licensed motor vehicle can park or drive by, including driveways and alleys, within 5 feet of an uncurbed pipeline or customer meter. A curb is considered to be adequate if it is continuous and parallel to the direction of normal vehicular travel. The extension of the vehicle's front or rear extremities shall be considered.
- C. At any location that is susceptible to vehicular stresses or forces that have the ability to damage a pipeline or customer meter.

15.10 Casings

- A. Casings containing a carrier pipe with the purpose of transporting natural gas shall be classified as one of the following:
 - 1. Highway or Rail Road Crossing Casing is a casing installed under the requirements of a permitting authority with the general purpose of facilitating construction, providing access for future repairs, and providing protection from external loadings or differential movement. This type of casing must be engineered to meet the requirements of 192.323.
 - 2. Insertion Casing is a conduit utilized during construction to simplify the installation process of a new gas main. Commonly the casing will be an existing pipe which has been abandoned from its original purposes.
 - 3. Protective Casing is a conduit which is chosen to be structurally sufficient to protect the carrier pipe from external loadings that have potential of damaging the gas main. Protective casings are commonly installed where minimum cover depth is not satisfied or other buried infrastructure is crossing within close proximity.
- B. Casings which will contain a gas main or service shall be installed subject to the following requirements:
 - 1. The type of material, weight or thickness, grade shall be sufficient to withstand trench load and anticipated live loads, including impact.
 - 2. Casings which will contain steel gas pipes shall have approved end seals that electrically insulate casing from gas pipe and provide a water-tight seal to prevent groundwater from entering the casing annulus.

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3. Casings which contain plastic gas pipes shall have special protection such as injected sealant foam or other material where plastic pipe exits the casing to prevent earth backfill load from pressing plastic against the casing. Also, 2" and larger plastic mains shall be provided with anchorage where main exits a casing.
 4. All casings which contain steel gas mains shall be vented. Casings which carry P.E. gas mains shall be reviewed by Engineering for venting requirements if the ends of the casing are sealed with materials other than expanding closed cell polyurethane foam insulation.
 5. One or two vents shall be installed on each casing installed under interstate highways, railroads, buildings and runways or taxiways. Vents must terminate in a manner which prevents rain or surface waters from entering the casing. Vents are not required on wall sleeves or short casings used for special (shallow main) protection. Vent to outdoors is required if casing runs through a habitable enclosed space.
 6. Approved casing insulators must be installed when a steel gas line runs through a steel casing.
 7. For plastic gas pipe installed in casings within the 5-foot frost zone, the casings must not exceed the size permitted in 17.05.I.
- C. If existing conduits or pipes are going to be repurposed as a casing, the proposed casing pipe shall be cleaned of debris and obstructions. Then the proposed casing pipe shall be televised to confirm the casing is free of imperfections that could potentially damage the gas main as it is being inserted. Additional cleaning or spot repairs are required until the carrier pipe can be inserted without risk of damage.
- D. All casing installation shall follow the corrosion protection requirements of Section 09.06.

15.11 Above Grade Piping Supports

Above grade distribution system piping, regulator stations, town border stations, and services 4" and greater shall be supported with the following practices:

- A. Supports shall be constructed of concrete and steel or other approved metals. Supporting saddles and pipe hoops shall have other isolating materials to protect from metal to metal contact.
- B. Supports must be installed such that expansion and contraction, differential settling, or frost will not induce excessive stresses upon the pipe.

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Where pipeline supports have not been designed with the applicable stresses in mind, they shall be fabricated with continuous adjustability.

- C. Supports shall be installed in horizontal piping runs that contain non-welded connections and a mechanical component (such as a valve or regulator) that could potentially be removed, leaving a cantilevered pipe 5 feet or longer. With welded joint connections, pipe supports shall be installed when horizontal runs exceed 14 feet.

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16.01 General

This section of the Standard Specifications establishes requirements and policies for the installation of steel gas distribution systems and a transmission line.

16.02 Handling of Pipe and Fittings

The Contractor shall have adequate equipment on the site for unloading, supporting, and lowering pipe and fittings into trench. Pipe shall not be rolled, dragged, dropped, or allowed to contact sharp or hard objects which could cause injury to the pipe or coating. Fabric slings or soft padded devices shall be used so as to protect the pipe or coating. Pipe and fitting should be adequately secured to limit movement during transporting. Pipe stored outside shall have ends capped to prevent entry of water or debris, except when it is possible to visually determine that the pipe is clean before installation.

16.03 Inspection of Pipe and Fittings

Before installation, all fittings, lengths, and sections of pipe shall be thoroughly cleaned inside and inspected for defects. Steel pipe shall be inspected for damaged ends, coating defects, and other abnormalities (192.461) (b).

Upon completion of the welds, they shall be visually inspected to insure compliance with the qualifying weld procedure.

Steel pipeline sections, after being welded and the joints coated, shall be electrically inspected by the Contractor in the Inspector's presence immediately before lowering the pipeline section into the trench. Each section of pipe must also be protected from damage resulting from adverse ditch conditions or damage from supporting blocks. Holiday inspection shall be performed on all pipe and fittings with an electronic holiday detector, supplied by the Contractor, and operated in such a manner as to audibly and visually detect the presence of all holidays. The inspection shall be performed as outlined in the latest revision of NACE Standard RP 0490-2001 with a certified holiday detector. This inspection shall occur on all buried piping. This shall be done by use of a "geeper" which detects coating defects. Coatings found defective shall be immediately repaired and geeped again. Correct geep voltage (1800 volts for 12-mil 3M Coating) shall be verified with the Inspector for the particular pipe coating before starting operation. Salvaged pipe to be reinstalled, which has wrapped bitumastic coating, shall have geep voltage set at 7200 V for 3/32" and 9600 V for 1/8" coating thickness. If a geep voltage is not specified by the manufacturer then the holiday detection voltage shall be determined by $V = 525\sqrt{T}$, where T = coating film thickness in mils. Proper voltage settings shall be confirmed by detecting three artificial holidays placed in the initial pipe joint. For fabrication inspection, the electrode shall be a wet sponge detector supplied by the Contractor. For pipe inspection, the electrode size shall be the pipe OD and consist of a rolling spring composed of square stainless steel wire. The spring

length shall fit securely to the surface of the pipe. The holiday detector manufacturers approved by the Department are:

- A. D. E. Stearns Company
- B. Spy Holiday Detectors
- C. Tinker & Rasor

Upon completion of the pipeline construction prior to final clean up, the Department may conduct a Pearson Survey to detect coating holidays. The Contractor shall uncover all of the holidays detected. The coating shall be cleaned, dried, geeped and uncovered coating defects shall be repaired. Any uncovered Pearson indications that do not require coating repair will be at the Department's expense and limited to the excavation, inspection, backfill and final cleanup. In either instance, all costs associated with the repair, including the excavation, coating repair, backfill and final cleanup will be borne by either the Contractor or the Department.

16.04 Cleaning Pipe Interior

Before joining, all fittings, lengths, and sections of pipe shall be inspected and thoroughly cleaned to remove all rust scale, dirt, snow, ice, water, or any other foreign material.

The Contractor shall install mechanical caps on the ends of all partially constructed mains and services for overnight periods or other periods of extended inactivity to prevent soil, water, and other materials from entering the pipe.

The completed pipeline shall be cleaned in the presence of the Inspector as follows:

- A. Steel pipe, 2" and smaller, shall be cleaned by blowing with air.
- B. Steel pipe, 3" and larger, shall be cleaned by blowing through a pig with air.

Alcohol shall be introduced in mains tested between September 1 and May 15. This shall be done prior to pigging. Contractor shall be furnished alcohol by the Department at 520 Garfield Avenue in amounts not to exceed the following per 1,000 feet:

2" - 0.4 Gallons	6" - 2.0 Gallons
3" - 0.6 Gallons	8" - 4.0 Gallons
4" - 1.0 Gallons	10" - 6.0 Gallons

16.05 Steel Pipe Installation

- A. Expansion joints shall be furnished and installed in accordance with Sections 14.02.04(P) at locations indicated on the Plans or designated by the Engineer in the distribution system.

- B. Bends in steel gas mains shall be made with weld fittings, approved bending equipment, except where deflections do not exceed 12-1/2 degrees, miter bends are permitted.

Wrinkle bends are not permitted.

No attempt shall be made to bend pipe except with bending equipment designed specifically for bending. Bending shall be within the allowable limits and meet the requirements of DOT Regulation, Section 192.313.

- C. Damaged sections of pipe shall be removed and replaced by cutting the section out as a cylinder, applying half-sole patch, or a full encirclement closure. Damage shall include dents, scratches, gouges, grooves, or arc burns which, in the opinion of the Engineer, could cause stress concentrations.
- D. A directionally drilled pipe that is installed which has the sacrificial coating partially or completely missing and the FBE coating intact shall be considered a successful bore. The Contractor shall provide means of internal inspection (geometry pig or approved alternate) to insure that the installed pipe is free of deleterious dents before tying the bore into the pipeline, as required by the Engineer.
- E. Pipe in open trench shall be installed as shown on detail drawing number EX-2 unless indicated otherwise on the plan. Where it is impossible or impractical to use encasement materials, rock shield (double wrapped around the circumference of the pipe and supplied by the Contractor) may be used as determined by the Engineer.
- F. Before backfilling, the pipe must be geeped with a holiday detector to confirm that no coating defects remain. Short replacement pieces or repairs to steel pipe need not be geeped.

16.06 Repair of Damaged Steel Pipe (192.307)

16.06.01 Transmission Main

Any repair on the transmission pipeline will require a procedure prepared by Engineering prior to any work. The pipeline will be taken out of service and pressure reduced below 20% of SMYS before any repair is made.

16.06.02 Distribution

- A. Damaged steel pipe which must be corrected includes:
1. Dent which in addition contains a stress concentrator such as a weld joint, an arc burn, scratch, or gouge.
 2. Dent which exceeds twice the wall thickness.

3. A scratch, gouge, or groove deeper than 12-1/2% of the wall thickness.
4. Arc burn.

A gouge, groove, arc burn or dent may not be repaired by insert patching or by pounding out. If these defects are removed, they may only be removed by cutting out the damaged portion as a cylinder.

Each segment of generally corroded distribution pipe with a remaining wall thickness less than that required for the MAOP of the pipeline or a remaining wall thickness less than 30% of the nominal wall thickness must be replaced or permanently repaired.

- B. Repairs requiring correction during construction should be accomplished by cutting the damaged section out as a cylinder unless an alternate method is approved by the Engineer.

Temporary repairs may be made with band clamps, sleeves or couplings, provided they are appropriately rated by manufacturer for pressure, size and suitability for use on steel gas lines. The permanent repair should be made within nine (9) months of temporary repair.

Permanent repairs required on a damaged steel pipeline which is in service may include:

1. Cutting out and replacing portion as a cylinder.
2. Complete full encirclement weld sleeve.
3. Halve sole weld-on repair patch for 6" and larger pipe.
4. Alternative repair composite reinforcement sleeve as approved by the Engineer.

Full encirclement weld sleeves and half-sole weld-on repair materials shall meet the more stringent of the following steel grade and thickness requirements: the current steel pipe specifications for each nominal size or match the steel grade and thickness of the pipe to be repaired.

All repairs of transmission and distribution steel gas pipe which require the replacement of pipe will be made using sections of pre-tested pipe that has been pressure tested to MAOP x 1.5 (Section 19) or at least 100 psi, whichever is greater. Repaired or replaced portions shall be rewrapped and/or coated in accordance with Section 25.

16.07 Joining Pipe and Fittings

16.07.01 General

Approved joints to be used for assembly of underground pipelines shall be according to the following tables unless detailed otherwise:

Table 16-1
Steel to Steel Joints

Joining Between	Type of Joint
Steel Pipe Sections	Welded
Steel Pipe and Fittings	Welded
Steel Pipe and Plastic (1", 2", 3", 6", 8")	Weld End Transition Fitting
Steel Pipe and Valves	Weld Flanges, 150# or 300# or weld end
Steel Pipe Insulators	Weld Flanges, 150# or 300#
Steel Pipeline Expansion Joint within long casings	Stainless Steel Bellows Type in manhole

Table 16-2
Plastic Pipe to Steel Pipe or Copper Risers

Joining Between	Type of Joint
5/8" Steel Service replaced with 1/2" plastic and 1" P.E. service replaced with P.E.	Existing old style Dresser 88 service tees must be refitted with new lock insert gasket, retainer cup & follower nut to conform to pullout resistance regulations. Otherwise, the tee must be abandoned & new 1" tees installed per 14.05.15 & Detail G-2.
5/8" O.D. steel or copper tube to 1/2" P.E.	Chicago Fitting

16.07.02 Welded Joints

Welders must be qualified according to the requirements of Section 27-Welding Qualifications.

- A. Cutting The edges or surfaces of parts to be joined by welding must be prepared by machining, grinding, flame cutting, or with a sanding disk. Edges prepared by flame cutting shall be dressed with a file, grinder, or sanding disk to produce a reasonably smooth and uniform surface. A flame cutting beveling machine shall be used to cut all 2" and larger pipe except that, where a beveling machine cannot be used, the pipe may be cut with a wheel pipe cutter and grinder beveled. The inside edge of pipe cut with a wheel cutter must be filed or reamed to remove the cutting burr.

B. Cleaning	All surfaces within 1" of the weld area must be dry, cleaned of all rust, scale, primer, oil, or other foreign material. The parts to be welded shall be free from greasy or oily matter at least 2" from the weld edge or surface.
C. Mitering	Miter joints may be made but not to exceed a total pipe deflection of 3° on the transmission gas line and 10° on the distribution gas mains. Increasing the deflection by using multiple miter bends properly spaced is permitted but discouraged in favor of cutting a standard bend fitting. If multiple miter joints are used, the minimum distance measured at the crotch from joint to joint must not be less than 1-1/2 pipe diameter.
D. Alignment	Line up clamps shall be maintained in place until at least 50% of the root bead is deposited at uniform spacing around the joint.
E. Protection	Tents or shields must be used when necessary to protect the weld area from rain, snow, or high winds. Liquid must not be permitted to come in contact with the weld area.
F. Preheat	The environment or weld material shall be preheated to at least 50°F.
G. Clearance	At least 24 inches of clearance under and around a joint should be provided for proper working space.
H. Configuration	See Standard Detail No. G-4.
I. Gas Vapors	Welding must be done only under controlled conditions in the presence of gas. A controlled flame at the weld or removing the combustible mixture from the weld area are the alternatives to be selected. Air movers or other means must be employed if gas is to be kept from the area. Gas detection instruments must be used to measure environment to insure any method employed to keep gas away is effective.
J. Cleaning Between Passes	Scale and slag shall be removed from each bead and groove between passes by grinding, brushing, or chipping.
K. Inspection	Acceptability of a weld that is nondestructively tested or visually inspected is determined according to API 1104, Section 9. All welds must be visually inspected to ensure compliance with the welding procedure.

Each person responsible for inspecting welded joints must be qualified by training or experience to ensure that the welding is performed to the procedure in this manual.

The Inspector reserves the option and without notice to have weld radiographed or to have test coupon cut as a supplement to visual examination. Cost of testing will be charged to Contractor if welds are not acceptable.

- L. Inspection of Transmission Welds All welds must be visually inspected to ensure compliance with the welding procedure. Inspection of welds on the transmission line will normally be done by a third party. The Department will keep on file and accept the NDE procedures utilized by the third party of their methods.

The welds on a pipeline to be operated at a pressure that produces a hoop stress of 20 percent or more of SMYS must be nondestructively tested in accordance with § 192.243, except that welds that are visually inspected and approved by a qualified welding inspector need not be nondestructively tested if:

1. The pipe has a nominal diameter of less than 6 inches (152 millimeters); or
2. The pipeline is to be operated at a pressure that produces a hoop stress of less than 40 percent of SMYS and the welds are so limited in number that nondestructive testing is impractical.

- M. Repair of Welds Welds found unacceptable according to API Standard 1104, Section 9, must be removed or repaired. Weld must be removed if it has a crack that is more than 8% of the weld length. Rejected welds on lines not in service shall be removed. Rejected welds on lines in service may be repaired or encapsulated. Welds which are permitted to be repaired must have the defect removed down to sound metal and the segment to be repaired must be preheated if conditions would adversely affect the quality of weld repair. The repair of a previously repaired weld will not be permitted and shall be removed.

16.07.03 Flanged Connections

Flange faces must be similar. Flat face flanges may not connect to a raised face flange.

Alignment of the flanges to be joined shall be done before bolting. Bringing unaligned pipelines together by tightening, resulting in a permanently sprung connection, is prohibited. Bolts or studs shall be long enough that, with the gasket or insulator

installed, they will extend completely through the nut with not less than two (2) exposed threads when tightened. Bolts or studs shall be tightened gradually and alternately so as to bring the flanges together with uniform and increasing pressure on all parts of the face.

See section 14.05 for torque requirements.

16.07.04 Steel (Extrude) to PE Repair Coupling, 5/8" ST to 1/2" PE Installation

The following procedure shall be used to connect 5/8" OD Steel or copper tube to 1/2" CTS (5/8" OD) PE pipe.

Installers of this fitting must be qualified according to Section 28.

- A. Cut plastic square and deburr O.D. and I.D. Clean exposed plastic line with a clean, dry, grease-free cloth.
- B. Mark tubing to stab depth at 1 1/2" from end with felt pen or suitable marker. Make sure not to scratch surface of plastic tubing with marker. Loosen nut 1 to 2 turns. Stab stiffener end of fitting over plastic service until plastic is bottomed. Flush with mark.
- C. Tighten body onto nut using suitable wrenches until body meets nut shoulder, that is, "metal to metal".
- D. Cut steel tube square, remove 1 1/2" of coating from end and deburr O.D. and I.D.
- E. Loosen nut one to two turns.
- F. Stab fitting over tubing until tube is bottomed and flush with edge of coating.
- G. Tighten nut onto body using suitable wrenches, until nut shoulder meets body, that is, "metal to metal". Steel end connection must have bitumastic applied and then taped.

16.08 Branch Main Connections, 2" and Larger

16.08.01 Connections to mains not in service

Connections to mains not in service may be made by the Contractor. Weld tees shall be installed where the branch and main are the same size or one size under. For branches more than one size under, saddles or tees and reducers may be used.

16.08.02 Connections to mains in service

Connections to mains which are in service (live) shall be done by the Department. The Department shall furnish and install saddles, nipples, and tapping valves, if required. The Department will furnish and install no-blo tees, stop off fittings, or bottom out fittings, if required.

Excavation, backfill and restoration shall be included as the Contractor's responsibility for all planned connections.

Hot tapping shall be performed only by trained & qualified personnel according to Section 16.09.

Department will furnish tools, machines, and personnel for any required operation as follows:

- A. Operate gas valves.
- B. Line stopper, bottom out connections, or by-pass operations.
- C. All tapping, drilling, cutting of mains.

Branch connections to mains in service (live) will follow these policies.

16.08.03 Branch Connection Policy to Steel Mains in Service
(Refer to detail G-3 or as spec on plan)

Branch Size	Main Size	
	Same as Branch	Larger than Branch
2"	2" No-Blo Valve Tee	2" No-Blo Valve Tee Weld Saddle w/Tap Valve
3"&4"	One Size Reduced Weld Saddle w/Tap Valve Bottom Out Stop (2" No-Blo Valve Tee for 3" PE Branch)	Weld Saddle w/Tap Valve Bottom Out Stop (2" No-Blo Valve Tee for 3" PE Branch)
6"-12"	One Size Reduced Full Encirclement Tap Tee w/Tap Valve Bottom Out Stop	Full Encirclement Tap Tee w/Tap Valve Bottom Out Stop

16.09 Hot Taps on Gas Main - Procedures, Training and Qualifications

Tap fittings shall be connected to mains only by qualified welders or fusers. No hot taps will be allowed on the transmission line without taking it out of service, pressure reduced and a procedure developed.

Tap fitting connection must be pressure tested for leakage before tapping begins.

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Operators performing hot taps shall be restricted to trained personnel listed in "Table of Hot Taps, Tools, Instructions and Qualifications". The operator (or at least one operator in the crew) shall have had the minimum training or certification listed in the schedule for each respective type of tap.

Instruction reference manuals or procedures shall be made available on the job site for each respective tap, except the self-tapping tees.

Table 16-3
Hot Taps, Tool, Instructions, Qualification

Type of Tap	Size	Detail	Machine Used	Operator(s)	Instruction Ref. & Qual.
3/4"x 5/8" Tap-N-Valve 1/2" x 5/8" mini-tee 3/4"x 1 1/8" Style 501	3/4" 1/2" 3/4"	G-2 G-2 G-2	None - self tap w/tool " "	Certified U.O. Personnel	Manuf. Manual " " Apprentice Program
Weldolet or Weld Saddle & Valve	2" & 3"	G-3	D-5 Mueller	Certified U.O. Personnel	Operating Instructions, Form 8513 Apprentice Program and Mueller Sch
Weldolet or Weld Saddle & Valve	4"	G-3	C1-36 Mueller	Certified U.O. Personnel	
Full Encirclement Tap Tee	6", 8", 10", & 12"	G-3	C1-36 Mueller	Certified U.O. Personnel	
No-Blo Valve Tee	1 1/4" & 1 1/2" & 2"	G-4	D-5 Mueller	Certified U.O. Personnel	Apprentice Program & Mueller Sch
(Completion plug for No-blo & drill nipples)	1", 1 1/4", 1 1/2" & 2"		H 17145 Mueller	Certified U.O. Personnel	
Stop	1 1/4" & 2"		D-5 Mueller	Certified U.O. Personnel	Low Pressure Line - Stopper Fitting Training Manual by Apprentice Program & Mueller Sch
(Completion Plugs)			H 17145	Certified U.O. Personnel	
Stop	All Sizes		C1-36 Mueller	Certified U.O. Personnel	Operating Instructions, Form 8513 Operating Instructions, Form 8834 Apprentice Program & Mueller Sch
(Completion Plugs)	3", 4", 6" & 8"		3SW Mueller	Certified U.O. Personnel	
	10" & 12"		4SW Mueller	Certified U.O. Personnel	

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17.01 General

This section of the Standard Specifications establishes requirements and policies for the installation of plastic gas distribution systems.

17.02 Handling of Pipe and Fittings

The Contractor shall have adequate equipment on the site for unloading, supporting, and lowering pipe and fittings into trench. Pipe shall not be rolled, dragged, dropped, or allowed to contact sharp or hard objects which could cause injury to the pipe or coating. Fabric slings or soft padded devices shall be used so as to protect the pipe or coating. Pipe and fitting should be adequately secured to limit movement during transporting. Pipe stored outside shall have ends capped to prevent entry of water or debris, except when it is possible to visually determine that the pipe is clean before installation.

Care shall be exercised at all times to protect plastic material from fire, excessive heat or harmful chemicals.

Plastic pipe and tubing shall be adequately supported during storage. Thermoplastic pipe, tubing, and fittings shall be protected from long term exposure to direct sunlight.

Extra care shall be taken when handling plastic pipe in cold weather below 40°F to avoid damage to the pipe ends caused by impact with hard surfaces such as frozen earth or concrete. Pipe shall not be dropped. Coils of pipe shall be warmed before pipe is uncoiled and shall be mounted on a device which rotates to permit a straight pipe when unreeled. Sprung or spiraled pipe shall be straightened by hand.

When it is necessary for the pipe ends to be cut during construction, the cut can be accomplished by various methods below:

- for sizes 3" or less, using a blade type of cutter, or a tubing cutter
- for sizes 4" or larger a guillotine pipe cutter shall be used.

Short pipe segments cut from pipes not installed can be cut with a sawsall, hand saw, or a chain saw (without bar oil) if the Department can visually inspect the pipe to be free of pipe shavings.

17.03 Inspection of Pipe and Fittings

Before installation, all fittings, lengths, and sections of pipe shall be thoroughly cleaned inside and inspected for defects. Plastic pipe shall be inspected for cuts, scratches, gouges, kinks, severe out-of-roundness, and other imperfections.

17.04 Cleaning Pipe Interior

Prior to fusion of fittings, the pipe shall be inspected and thoroughly cleaned to remove all dirt, snow, ice, water, pipeline shavings, or any foreign material. If any foreign materials are found in a section of pipe, the section must be pigged repeatedly until pig exits clean and dry prior to joining pipe sections or fittings. The first pass shall be done without adding alcohol. The use of new pigs is necessary to prevent contamination from dirty pigs, as directed by the Inspector.

The contractor shall install mechanical or fusion caps on ends of all partially constructed mains and services for overnight periods or other periods of extended inactivity to prevent soil, water, and other material from entering the pipe. Duct taping of pipe ends is not acceptable. Fusion caps may be required on any main or service installed in the ground where ends of pipe cannot be raised above trench.

The pipeline must be cleaned prior to installing of tees.

The completed pipeline shall be cleaned in the presence of the Inspector as follows:

- A. Plastic pipe, 1" and smaller, shall be blown with air.
- B. Plastic pipe, 2" and larger, shall have a foam pig blown through with compressed air. The pig shall be sent through the main repeatedly until it exits clean and dry. If any dirt or water is present on the pig, a new clean pig must be resent through the main.

Methanol (ALKY) shall be introduced in mains tested between September 1 and May 15. ALKY shall be introduced before pig is installed for final pigging. Contractor shall be furnished methanol ALKY by the Department at 520 Garfield Avenue in amounts not to exceed the following per 1,000 feet:

- 2" - 0.4 Gallons
- 3" - 0.6 Gallons
- 4" - 1.0 Gallons
- 6" - 2.0 Gallons

For mains 8-inch and larger, the actual amount will be determined by Engineering.

17.05 Plastic Pipe Installation

- A. Plastic pipe shall be laid with uniform support on undisturbed or well compacted soil. Pipe bed shall not contain large rocks, blocks, or any other material which could injure the pipe or result in non-uniform support.
- B. Plastic pipe shall be laid and backfilled with its natural slack in trenches. Excessive tension to straighten out pipe is not permitted.

- C. Locating wire shall be laid 6 inches above every plastic gas pipe when open cut. Locating wire shall be tested for continuity.

Service locating wire shall be connected to main locating wire.

Locating wire shall remain continuous to the greatest extent possible. All connections shall be protected to make them watertight except the ends where they are brought up in valve boxes or at service risers.

Locating wire, at valves, shall be brought up in valve box using 1/2" PE section to enclose the wire.

Two wires shall be pulled on all directional drilled installations of main and 2" or larger services.

Locate wire and connectors placed during directional boring must be approved prior to work being performed. Locating wire pull-out prevention is required at all buried wire connections as follows:

Copper wire - Bend and fold ends around split bolt connector

Stainless cable - Tie an overhand knot in the cable with the splice located in the loop of the knot.

All locating wire shall be tested for continuity. Payment shall not be made for main or service without a properly functioning locator wire.

- D. Bending plastic pipe is permitted up to the radius of its shipping coil. Pipes 4 inch and larger may be deflected to a minimum radius of 125 times pipe diameter at joints and 20 times the pipe diameter otherwise.
- E. Pulling plastic pipe through auger and bore holes may be done with power equipment only if a "weak link" section, approved by the Engineer, is used in the pulling assembly. Every effort should be made to pull and/or push the inserted pipe through by hand. If winch or machine power is required, a "weak link" designated by the Engineer shall be used in the pulling assembly. Weak link may be a pulling head or next smaller diameter pipe of the same SDR or greater than that being pulled.
- F. Pipe shall not be installed in cold weather (40°F or less) except in a special arrangement and with approval of the Engineer.
- G. Installation of plastic pipe by plowing is permitted provided the pipe is not stretched at any time in the operation. Plow chute shall not bend pipe more than a radius of 15 times pipe diameter.

- H. Installation of plastic pipe by pull plug is not permitted.
- I. Installation by insertion in casing pipes or abandoned mains shall meet all requirements of Sections 9.06 and 15.10. Insertion shall be preceded by proper preparation of the existing abandoned main. Obstructions such as old service taps, bends, drips, etc., shall be cut out and the leading pipe ends padded as necessary to prevent scratching the inserted pipe. Locating wire shall be laid to and attached to casing or laid inside the casing or both depending upon conditions. Pipe inserted through more than 100' of casing will require anchors at each end to restrain the plastic main. The Engineer will provide an anchor detail. Openings at casing ends where pipe is inserted through less than 100 feet of casing and without anchors shall be sealed with closed cell polyurethane foam.

When plastic gas pipe is inserted through a steel casing, the tracer wire shall be attached by cadweld to each end of the casing prior to pipe insertion.

Ends of casing or cut pipe shall be at least 12 inches from any connecting service with branch tee.

Plastic pipe installed through casings which are in the 5-foot frost zone are subject to being squeezed off by ice. Casings subject to these conditions must be sized as follows:

1/2" PE Gas Pipe	3/4" or 1" Casing
1" PE Gas Pipe	1 1/4" or 1 1/2" Casing
2" PE Gas Pipe	2 1/2", 3", 4" Casing
3" PE Gas Pipe	4", 6" Casing
4" PE Gas Pipe	6", 8" Casing
6" PE Gas Pipe	8", 10" Casing
8" PE Gas Pipe	12" Casing
12" PE Gas Pipe	16" Casing

- J. Pneumatic tunneling (moling) shall be done with caution to avoid damage to foreign utilities. When it is not clear that elevation or location clearance can be maintained, the Contractor shall expose the foreign utility before tunneling. The Engineer may further limit lengths between excavations to insure that depth limitations are not either excessive or insufficient. Follow procedure in Section 15.03 for sewer main or service crossing.
- K. Plastic gas mains 4" or larger in size and in open trench shall always be installed as shown on detail drawing number EX-2 unless otherwise indicated on the plans. This shall not apply when pipe is inserted through bored holes. Cost of bedding and cover shall be included in unit bid price for pipe installation.

17.06 Repair of Damaged Plastic Pipe

Damaged pipe requiring repair or replacement include scratches or gouges which have a depth of 10% or more of the wall thickness, pipe which has been stretched or kinked beyond the elastic limit; i.e., will never recover original shape or length, except for a squeeze off location.

Repair of defects during the construction of plastic pipelines should be accomplished by cutting out the defective parts and replacing section by using the same materials and methods for new construction.

After a plastic pipeline has been in service, a number of approved fittings (Section 16.07) may be used to repair or replace defects. Repairs must also be made to plastic pipe using sections of pipe that has been pre-tested to 100 psi.

Whenever plastic pipe is squeezed off for any reason, the location of the squeeze or pinch must be permanently marked with wraps of electrical tape or a split plastic clamp so the location will not be used for another squeeze-off in the future.

When repairs have been made, the tracer wire must be reconnected for continuity. Connections are to be made with 3M type connectors or approved equivalent and must be made waterproof by the use of 3M 2200 pads or approved equivalent. Tracer wires are not to be attached to the steel gas main, steel services, or service tees.

17.07 Joining Pipe and Fittings - General

Approved joints to be used for assembly of underground pipelines shall be according to the following tables unless detailed otherwise:

Table 17-1 Plastic to Plastic Pipe Joints	
Joining Between	Type of Joint
1/2"	Socket Fusion The following may be installed only by the Department in the following conditions: • Continental Con-Stab Coupling for existing service relocations • Continental Con-Stab Cap-N-Go for temporary services • Continental Con-Stab End Cap for temporary abandonments
1"	Socket Fusion or Electrofusion
2" and 3"	Socket, Butt Fusion, or Electrofusion
4", 6", 8", 10" and 12"	Butt Fusion & Electrofusion*

- * Where electrofusion couplings are used to join pipe to fittings (tees, elbow, etc.), a minimum 2' stub shall be installed between the fitting and coupling to allow for future repairs.
- ** MDPE pipe and HDPE pipe shall not be directly butt fused to each other.

Table 17-2 Plastic to Plastic Repair	
Joining Between	Type of Joint
1/2"	Socket Fusion Coupling or "Continental Con-Stab" Type Plastic Pipe Repair Coupling, Cap-N-Go, or End Cap when installed by the Department
1"	Socket Fusion Coupling or Electrofusion
2" and 3"	Electrofusion coupling, socket fusion coupling, or butt fusion
4", 6", 8", 10" and 12"	Butt fusion and electrofusion coupling*
4", 6", 8", 10" and 12" (temporary)	Band clamp may be used for temporary repairs. Permanent repairs must be scheduled.

- * Where electrofusion couplings are used to join pipe to fittings (tees, elbow, etc.), a minimum 2' stub shall be installed between the fitting and coupling to allow for future repairs.

Table 17-3 Plastic to Plastic Tapping Tee	
Joining Between	Type of Joint
1/2", 1", & 2" tee on 2", 3", 4", 6", 8", 10" & 12" main	Saddle & Electrofusion

- * Where electrofusion couplings are used to join pipe to fittings (tees, elbow, etc.), a minimum 2' stub shall be installed between the fitting and coupling to allow for future repairs.

17.08 Fusion Joining of Plastic Pipe

All fusion joining shall be done only by persons currently certified by the Public Works and Utilities Department according to these Standards.

All fusion joining equipment shall be maintained in accordance with the manufacturer's written procedures or recommended practices that have been proven to reliably produce acceptable joints through testing and experience (192.756). To sustain

reliability, all fusion joining equipment shall be inspected for damage, defects, and proper performance no less than annually.

Skillful application of techniques and the use of proper materials and equipment in good condition are required to achieve sound joints in plastic piping by the heat-fusion method. Inspection provisions shall be adequate to assure that sound joints are being made. The quality of the joints shall be checked visually. If there is any reason to believe the joint is defective, it shall be removed and replaced.

Alcohol shall be used for cleaning and preparing the fusion surfaces on the pipe. Alcohol shall be 96% or greater isopropyl concentration.

No fusion joining shall be done unless the proper and full quantity of tools is used.

Fusion joining between different types of plastics shall only be made to connect a service tee or branch saddle to the tan Dupont Aldyl "A" 6" pipe. Respective heating cycles for each type of plastic are listed in Table 17-10.

Connections between MDPE and HDPE shall only be made with electrofusion couplings. Direct butt fusion between the materials is not allowed.

Direct application of heat with a torch or other flame is prohibited.

Special procedures outlined below shall be applied for fusion joining in cold weather. No work shall be done when it is below 0°F, raining, sleeting, or snowing, unless an artificial shelter is provided to enclose the work sufficiently to maintain an environment to comply with these specifications.

17.09 Socket Fusion Joint Procedure

A. End Preparations

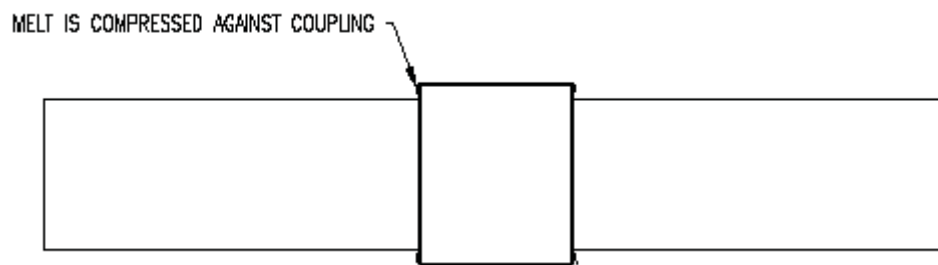
1. Using a pipe cutter, cut off damaged or oval ends of pipe squarely.
2. Using chamfering tool to remove about 1/16" of the sharp corner at the pipe end on the outside surface of pipe. Remove burrs and chips inside pipe ends.
3. To prepare pipe for correct penetration into socket, place depth gauge down flush on end of pipe.
4. Place cold ring clamp around pipe, adjacent to depth gauge. After securing cold ring clamp, remove depth gauge.

5. Fitting surfaces should be clean and dry--wipe with cloth--do not touch with hands. Clean surfaces with alcohol and lint free material.
6. The socket faces of the heating tool should be at $500^{\circ} \pm 10^{\circ}\text{F}$ and clean.
7. First, firmly seat the socket fitting on the male face of the heating tool. Then place the female face on the end of the pipe firmly against the cold ring clamp. Heating time starts now.

B. Heating

1. While holding the fitting firmly in a fixed position, rotate heating tool slightly to feel the melt, and promote uniform heating of pipe and fitting.
2. Snap the heating tool and fitting from the melted pipe by holding upper part of tool handle with one hand and rapping sharply on the handle with the free hand. Immediately remove fitting from heating tool.
3. The heated parts are inspected quickly to make sure all surfaces have been melted. See Figure 17-1.
4. If melt is not complete, cut off melted pipe end, use a new fitting, and repeat fusion process from the beginning.

Figure 17-1
Socket Fusion

**C. Fusion and Cooling**

1. Within 3 seconds after the heating tool has been removed, firmly push the melted fitting squarely onto the pipe and until it makes firm contact with the cold ring clamp. DO NOT TWIST. Hold the fitting firmly in place for total cooling time shown in Table 17-4 to insure proper alignment.
2. After waiting 3 additional minutes cooling time, remove the cold ring clamp and inspect the joint. A good joint will have a uniform melt ring that is flat against

the socket and perpendicular to the pipe. There should be no cavity between the fitting and the pipe.

3. Wait an additional 10 minutes to complete cooling before the pipe joint is tested or stressed during burial.

Table 17-4 Socket Fusion Time Cycles – Yellow or Orange Pipe		
Pipe Size (inches)	*Heating Time Cycle (seconds)	Cooling Time Cycle (seconds)
1/2" CTS	6	30
1" CTS	9	30
2" IPS	16	45
3" IPS	20	60

- * Guidelines only, exact time depends on environmental conditions and condition of fusion equipment.

17.10 Saddle Fusion Joint Procedure -Yellow or Orange Pipe

The use of application tool is required for installing service tap tees and service saddles. An application tool is required for installing branch saddles. Assemble application unit according to manufacturer's instructions and position on pipe.

A. Surface Preparation

1. Remove surface skin from the melt areas of the clean, dry pipe and saddle fitting by roughening with medium grit emery or garnet cloth.
2. Brush away residue with dry rag after roughening. Clean area with alcohol and lint free material.

B. Heating

1. With the heating surfaces of the tool at $500^{\circ}\pm 10^{\circ}\text{F}$ place the tool in position on pipe. Place fitting against heater faces and apply pressure.
2. Heat for time shown in Table 17-5 or 17-6.
3. With experience, the iron can be rotated slightly and slowly as the melt forms-
-do not rotate excessively as this will enlarge the melt pattern on the pipe.

Table 17-5 Service Tap Tee and Service Saddle Fusion Time Cycles		
IPS PIPE SIZE (INCHES)	*HEATING TIME CYCLE (SECONDS)	COOLING TIME CYCLE (SECONDS)
2	30	60
3	40	60
4	40	60
6	40	60
8	40	60
12	40	60

Table 17-6 Branch Saddle Fusion Time Cycles - with 2" Outlet		
IPS PIPE SIZE (INCHES)	*HEATING TIME CYCLE (SECONDS)	COOLING TIME CYCLE (SECONDS)
2	60	120
3	70-80	120
4	75-90	180
6	80-90	180
8	80-90	180
12	Visual	180

* Guidelines only, exact time depends upon environmental conditions and conditions of fusion equipment.

- After proper melt time, raise fitting and remove heater from pipe. DO NOT displace melt on pipe and fitting surfaces. Check melt pattern on pipe and fittings--heated surfaces on fitting and pipe should be 100% melted with no cold spots. (Use a mirror to check the melt on the under surface of the saddle base.)

C. Fusion and Cooling

- If melt patterns are satisfactory, press the fitting on the pipe quickly (within 3 seconds) with a pressure of 60-80 psi until a melt bead of the following size appears around the entire base of the fitting:

PIPE SIZE
2"

BEAD THICKNESS
1/8"

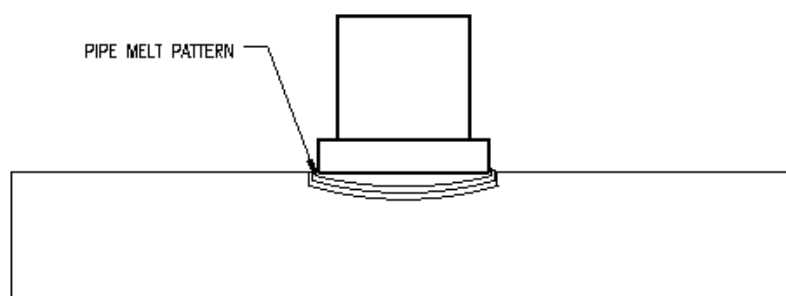
3" & larger

larger than 1/8"

Adjust fusion unit to maintain pressure of fitting on pipe. Allow fusion joint to cool for at least the times indicated in Table 17-5 or 17-6 before releasing pressure. If melt pattern on fitting or pipe is unsatisfactory after heating, apply fitting to pipe and let cool. Remove cutter from tapping tee and cut off fitting top to avoid misuse later. Repeat procedure from Step (a).

2. After letting joint cool 3 minutes beyond that shown in the tables, remove application unit from pipe.
3. Visually check fitting for fusion melt bead around entire fitting base. See Figure 17-2 for visual parameters of proper Saddle Fusion. If fusion joint quality is unacceptable or doubtful, cut off fitting top and apply a new fitting to a new section of pipe.
4. Let fusion cool an additional 10 minutes prior to pressure testing and tapping the main.

Figure 17-2
Saddle Joint



17.11 Butt Fusion Joint Procedure

A. End Preparation

1. Clean each pipe end with alcohol using lint free materials.
2. Insert facing unit between pipe ends and lock onto guide rods. Face ends of pipe to be fused.
3. Check alignment of pipe ends. Adjust high-low if necessary. If adjustment is made, reinsert facing unit and give several additional turns without repositioning the pipes in the clamps.
4. Check heater plate for temperature and wipe surface clean.

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B. Heating

1. Insert heater plate between aligned ends and bring ends firmly in contact with plate, but DO NOT APPLY PRESSURE.
2. Heat for times shown below.

Table 17-7 Butt Fusion Time Cycles for Orange or Yellow MDPE Pipe			
IPS PIPE SIZE (INCHES)	*HEATER AT 500°(+10°F	*HEATER AT 440°(+10°F	COOLING TIME CYCLES (SECS.)
2	15	40	150
3	20	50	200
4	30	60	260
6-SDR 21	25	60	210
6-SDR 11.5	40	90	390
8-SDR 11.5	62	100	495

Table 17-8 Butt Fusion for Dupont Aldyl "A" (Tan) Pipe		
IPS PIPE SIZE (INCHES)	*HEATER AT 340(+5°F	COOLING TIME CYCLE (SECONDS)
6" - SDR 21	120	120
6" - SDR 11.5	150	150

Table 17-9 Butt Fusion for Black HDPE Pipe		
IPS PIPE SIZE (INCHES)	*HEATER AT 440(+5°F	COOLING TIME CYCLE (SECONDS)
12" - SDR 11	Visual	732

* Guidelines only, exact time depends upon environmental conditions and conditions of fusion equipment.

** MDPE pipe and HDPE pipe shall not be directly butt fused to each other.

C. Fusion and Cooling

1. Remove heater plate after achieving proper melt bead.

2. Bring melted ends together rapidly. DO NOT SLAM. Apply enough force to achieve a double roll back of each bead onto the pipe.
3. Allow the butt fusion to cool, under pressure, for the time shown in Table 17-7, Table 17-8, and Table 17-9.
4. DO NOT remove the fused joint from the equipment for an additional 3 minutes after cooling time or until the joint temperature has cooled to 140 degrees F.

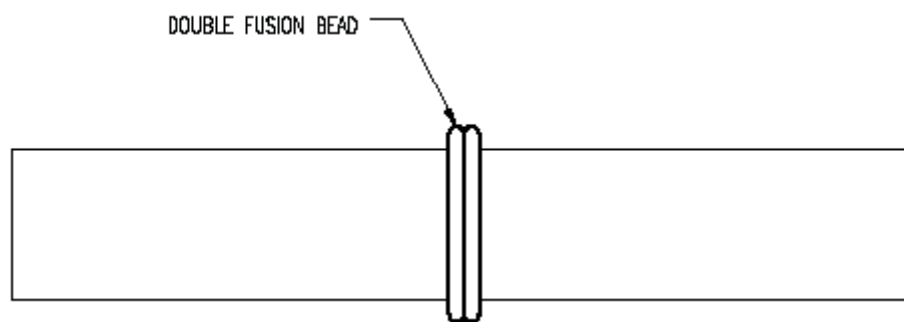
DO NOT test, stress, pull or lay in ground for 10 minutes after removal from fusion unit.

5. See Figure 17-3 for visual parameters of a proper fusion.

Each bead after fusion should have approximately the following diameters:

Table 17-10 Bead Diameter after Fusion		
PIPE SIZE	SDR NO.	BEAD THICKNESS
2" IPS	11	1/16" TO 1/8"
3" IPS	11 - 13.5	1/8"
6" IPS	11 - 13.5	3/16"
8" IPS	11 - 13.5	1/4"
12" IPS	11 - 13.5	1/4" TO 3/8"

Figure 17-3
Butt Joint



17.12 Procedure for Fusion Joining of Fittings and Pipe Having a Different Base Plastic

Orange and yellow pipe and fittings are of the same base plastic and require no differential time for fusion joining.

Orange or yellow fittings, when being fusion joined to tan colored Dupont Aldyl "A" pipe, require a differential in the required heating times. The tool temperature ($500^{\circ}\text{F} \pm 5^{\circ}$) does not change for orange/yellow or tan material when making saddle type fusions.

The heating tool shall be first placed on the yellow or orange saddle fitting, which requires a longer heating time; then after the difference in heating time has lapsed between the materials, the companion heating tool is applied to the tan pipe. Both tools are to be removed simultaneously when the remaining time expires. Tables 17-5 and 17-6 shall be used for the orange or yellow heating cycles and the following Table 17-11 for tan colored Dupont Aldyl "A" material.

Table 17-11 Fusion Time Cycles for Tan Dupont Aldyl "A" Pipe and Yellow or Orange Saddle Fittings		
*HEATING TIME ON TAN DUPONT ALDYL PIPE YELLOW SADDLE (SECONDS)	*HEATING TIME ON ORANGE OR COOLING TIME (SECONDS)	CYLCLE (SECONDS)
Service Tap Tee/ Service Saddle 20	40	120
Branch Saddle 35-45	60	120

DO NOT remove the fused joint from the equipment for an additional 3 minutes after cooling time.

- * Guidelines only, exact time depends upon environmental conditions and conditions of fusion equipment.

17.13 Cold Weather Fusion Procedures for Socket, Saddle, and Butt

Cold weather fusion procedures established below shall be used when temperature is between 0°F and 40°F .

1. All traces of frost, ice, and water shall be removed from both the joining and clamping surfaces. Heating tools shall not be used for this purpose.
2. Cold ring clamps shall be used to check ends of pipe to be joined. If ends of pipe are damaged or distorted, they shall be cut off.
3. Two cold ring clamps may be necessary (one behind the usual location of the first clamp) to prevent slipping due to pipe construction. Shim material of paper or tape must only be inserted in the secondary cold ring, allowing room for expansion of the pipe in the first cold ring during heating cycle.

4. Socket Fusions. The fitting shall be placed on the tool before stabbing the pipe into the tool. Time, in the following table, begins when the pipe is completely on tool. When time is up, snap the pipe from the tool first, followed by the fitting.
5. For cooling times, see Procedures A through D.

FUSION TIME (SECONDS) - COLD WEATHER

Temperature	40°	30°	20°	10°	0°
1" & 2" Sockets	21	22	23	27	28
3" Sockets	22	23	24	28	29

Saddle Fusions. Apply the heating cycle in the above table, substituting main size. If melt is not satisfactory, begin at new location and increase time by not more than 3 seconds per trial.

Butt Fusions. Apply the same heating cycle as in warm weather. If good joint is not obtained, cut out joint, repeat procedure increasing heating cycle. Do not increase pressure on joint to compensate low temperatures.

17.14 Plastic Pipe Couplings, LYCOFIT Installation Procedure, 1/2" SDR 7 Pipe

- A. Make sure size and wall thickness or SDR marked on LYCOFIT matches those of pipe to be joined. Refer to illustration package with each fitting.
- B. Make sure inside and outside of pipe and LYCOFIT are clean and dry. **DO NOT LUBRICATE PIPE, TUBING OR LYCOFIT!**
- C. Slide LYCOFIT SLEEVES onto pipe first.
- D. Position pipe jaw vise grip on pipe. Use only the LYCOFIT assembly tool, insert LYCOFIT spigot into pipe until pipe covers last barb on spigot. **DO NOT INSERT AGAINST PIPE STOP.**
- E. Remove vise grip, advance the LYCOFIT sleeve over the pipe until it meets the flange on the spigot.
- F. Pressure test to comply with Construction Specifications.

17.15 Plastic Pipe Stab Couplings, Con-Stab Installation Procedure, 1/2" SDR 7 Pipe

- A. Verify the pipe or tubing being assembled is the correct size.
- B. Cut pipe ends square.

- C. Clean piping thoroughly to assure there is **no dirt, grease or oil in assembly area**.
- D. Chamfer end of pipe using the Continental O.D./I.D. chamfering tool.
- E. Mark the stab depth using one of the methods listed below.
 - 1. Holding the piping against the collar on the fitting, mark the pipe at the entrance of fitting.
 - 2. O.D./I.D. chamfering tool is also a depth gauge. Insert pipe into tool until it stops, mark pipe at entrance of tool.
 - 3. Measure stab length, which is 1-7/8" from chamfered end of piping.
- F. Stab pipe completely into fitting so that the mark on the pipe is within 1/8" from the fitting entrance.
- G. Pressure test to comply with Construction Specifications.

17.16 Electrofusion Couplings (1", 2", 3", 4", 6", 8", 10", 12") Installation Using an Approved Electrofusion Unit

A. Electrofusion Joining Equipment Calibration

Electrofusion processing equipment shall be factory calibrated annually, not to exceed 15 months. Each electrofusion processor shall be identifiable with a unique serial number. A sticker affixed to the equipment or documentation accompanying new equipment shall identify the most recent date of calibration and the company which performed the calibration. Electrofusion processing equipment not containing this documentation of calibration history shall not be used to perform electrofusion. At any time, electrofusion equipment with a history of poor performance may be rejected for use by an Engineering Division representative.

B. Electrofusion Joining Procedures:

- 1. Clean the pipe ends by removing dirt, mud, and other debris, with a clean, disposable lint free material. Clean water can be used for initial cleaning prior to peeling and isopropyl alcohol is recommended after peeling.
- 2. Check pipe for out-of-round condition. If fusion area is found to be out-of-round, take appropriate steps to bring fusion area back within required tolerances.

3. When preparing pipes to install an electrofusion coupling, cutting of the pipe ends shall be accomplished by using a blade type cutter, tubing cutter, or guillotine pipe cutter.
4. Cuts to pipe end shall be as square as possible with a maximum out of square of 3 degrees.
5. Measure the stab depth on both pipe ends by placing the coupling next to the pipe as required by the manufacturer and marking the depth with a non-greasy marker.
6. Check the pipe surface for any embedded debris that may cause damage to the peeling tools and once more make sure that the outer pipe surface is clean and free of any dirt or mud that could contaminate the peeled pipe surfaces.
7. Peel the outside of the pipe surface to remove oxidation and other contaminants. Use an appropriate peeling tool, as recommended by the pipe or fitting manufacturer and approved by the Public Works and Utilities Department. Peel the pipe surface until the outer layer or "skin" of the pipe has been removed to expose a clean, virgin pipe material as per pipe manufacturer's recommendation. Inspect the entire peeled area to ensure total peeling coverage. For pipe smaller than 6-inch, if a coupling is to be pushed completely over one pipe end, peel the pipe end for the entire length of the coupler to prevent contamination of the coupler by sliding over unpeeled pipe. **Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.**
8. Clean peeled area thoroughly with a clean, lint free towel and isopropyl alcohol and allow to dry before assembly. Avoid touching the peeled pipe surface or the inside of the coupler as body oils and other contaminants can affect fusion joint performance. If the surfaces become contaminated, repeat cleaning procedure. Do not use alcohol with any additives other than water.
9. Place the fitting on the area to be fused and restrain using an approved restraint device.
10. Attach processor leads to the fitting and proceed with fusion as described for standard joining, per manufacturer's instructions.
11. Disconnect and remove processor leads when fusion cycle is complete.
12. Allow fitting to cool in accordance with recommended cooling time before pressure testing or rough handling.

C. Electrofusion Couplings:

1. For New Installation:

Slide coupling half-way over one pipe end. Slide mating pipe into other half of coupling so that the coupling lines up between the marks made in step 4 of **Electrofusion Joining Procedures**.

2. For Repair:

Slide one coupling over each end of repair section of pipe. Position repair section of pipe in place between existing pipe ends. Slide couplings over the joints to line up between the marks made in Step (d) of **Electrofusion Joining Procedures**.

17.17 Electrofusion Tapping Tees (2", 3", 4", 6", 8", 12") Installation Using an Approved Electrofusion Unit

Electrofusion Tapping Tee Procedures

1. Clean the area of the pipe to be fused by removing dirt, mud, and other debris, with a clean, disposable lint free material from pipe ends. Clean water can be used for initial cleaning prior to peeling and isopropyl alcohol is recommended after peeling.
2. Check pipe for out-of-round condition. If fusion area is found to be out-of-round, take appropriate steps to bring fusion area back within required tolerances
3. Identify the location of the fitting to be installed on the pipe, as recommended by the manufacturer, by marking the area with a non-greasy marker.
4. Check the pipe surface for any embedded debris that may cause damage to the peeling tools and once more make sure that the outer pipe surface is clean and free of any dirt or mud that could contaminate the peeled pipe surfaces.
5. Peel the outside of the pipe surface to remove oxidation and other contaminants. Use an appropriate peeling tool, as recommended by the pipe or fitting manufacturer and approved by the Public Works and Utilities Department. Peel the pipe surface until the outer layer or "skin" of the pipe has been removed to expose a clean, virgin pipe material per pipe manufacturer's recommendation. Inspect the entire peeled area to ensure

total peeling coverage. **Do not use abrasives, grinding wheels, or other devices that do not cleanly remove the contaminated material.**

6. Clean peeled area thoroughly with a clean, lint free towel and isopropyl alcohol and allow to dry before assembly. Avoid touching the peeled pipe surface or the inside of the coupler as body oils and other contaminants can affect fusion joint performance. If the surfaces become contaminated, repeat cleaning procedure. Do not use alcohol with any additives other than water.
7. Remove the fitting from the bag. Clean fitting with alcohol and lint free towel if needed, then place it in the area to be fused.
8. Without moving the fitting, slide the under clamp onto the base of the fitting.
9. Make sure the fitting is centered in the under clamp and then pull the cantilever into the secure position.
10. Attach processor leads to the fitting and proceed with fusion as described for standard joining, per manufacturer's instructions.
11. Disconnect and remove leads when fusion cycle is complete.
12. Allow fitting to cool in accordance with recommended cooling time before pressure testing or rough handling.

17.18 Re-Fusion of Electrofusion Fittings

Central Plastics electrofusion fittings can be re-fused (Engineering or welders approval needed) only in the event of an input power interruption, i.e. fusion leads were detached during fusion, generator runs out of gas, processor malfunction, or other circumstance that results in processor input power interruption.

The recommended procedure for re-fusing fittings is:

- a. Fitting should remain in clamped position and be allowed to cool to ambient temperature.
- b. The fitting should be reconnected to the processor and fused for the entire fusion time.

This re-fusion procedure should be used for fusions that terminated due to input power reasons only.

Fittings that fault for any other reason should be cut out and replaced.

17.19 Branch Main Connections, 2" and Larger

Connections to mains not in service may be made by the Department or the Contractor. Fused tees shall be installed where the branch and main are the same size or one size under. For branches more than one size under, saddles or tees and reducers may be used.

Connections to mains which are in service (live) shall be done by the Department or the Contractor where tapping tees or high volume tapping tees are used. Connections to live mains which use saddles shall only be completed by the Department.

Excavation, backfill, and restoration shall be included as the Contractor's responsibility for all planned connections.

Hot tapping shall be performed only by trained & qualified personnel according to Section 17-21.

Department will furnish tools, machines, and personnel for any required valve operation on existing mains.

For squeezing of existing PE gas mains, the Contractor shall squeeze all 3-inch and smaller mains and services for the proposed work. The Department shall furnish tools, machines, and personnel for squeezing all 4-inch and larger mains.

Branch connections to mains in service (live) will follow these policies.

17.20 Branch Connection Policy to Plastic Mains in Service

Plastic branch connections to live plastic mains will be made with branching saddles or electrofusion high volume tapping tee. Saddle shall be the same plastic type and grade as the live plastic main. Different plastics shall join at socket joints when necessary.

17.21 Hot Taps on Gas Main - Procedures, Training and Qualifications

Tap fittings shall be connected to mains only by qualified welders or fusers.

Tap fitting connection must be pressure tested for leakage before tapping begins.

The person performing the hot tap shall be OQ qualified for the specific task.

Instruction reference manuals or procedures shall be made available on the job site for each respective tap, except the self-tapping tees.

Table 17-12
Hot Taps Schedule

Type of Tap	Size	Detail	Machine Used	Operator(s)
PE Service Tees	½" & 1"	G-10 G-11	None - self tap w/hex tool	Welders Contractor Certified U.O. Personnel
PE Branch Saddles	2" & 3"		Dupont 2" B.S. Tapping Tool	Welders
Electrofusion High Volume Tee	2"		High Volume Tapping Tee Tool	Welders Contractor Certified U.O. Personnel

SECTION 18: VALVE INSTALLATION

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SECTION 18: VALVE INSTALLATION

18.01 General

This section of the Standard Specifications establishes requirements and policies for the installation of both steel and plastic gas distribution and transmission valves.

18.02 Valves

Flanged valve shall be installed where indicated on the Plans. Valves shall be set upright, on blocks to undisturbed earth and backfill tamped around and up to a point 4 to 6 inches below the top of operating nut.

The box, as specified in Section 14.05.05, shall be adjusted to proper height by first cutting the top stem of the plastic bottom section. If necessary, the bonnet portion may be trimmed to shorten the height. Bottom section shall be set on 2-inch wood blocking and uniformly backfilled to keep the box plumb and on center. Box shall not rest on valve or on main.

Valves installed on the inlet side of regulator stations will be located at sufficient distance to permit the operation of the valve during an emergency.

Valve types, when not indicated on the Plans, shall be determined from the following current Department practice:

	PE Ball Valve 1"	PE Ball Valve 2" & 3"	PE Ball Valve 4", 6", & 8"	PE Ball Valve 12"	Steel Gate (Kerotest) 2" & over	Steel Ball 2" & over
Line Valves in PE Mains		X	X	X		
PE to PE Branch	X	X	X	X		
PE Service	X	X	X			
PE Branch Off Steel with No-blo Tee Connex		X				
Tap Off Steel Main					X	X
Reliefs (Above Ground)					X	X
Line Valves for Steel Mains		X	X	X	X	X
Steel Risers (2" & larger)					X	X
Reg. Station (Above Ground)					X	X

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SECTION 19: TESTING HP GAS PIPELINES AND SERVICES

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19.01 General

All testing apparatus shall be furnished and installed by the Contractor. Cost of testing shall be incidental to the main or service. Mechanical test gauges used by the Contractor shall be a minimum 2 ½" diameter. Gauge shall display units in PSI from 0 to 120 or 0 to 160 and shall have intermediate increments of 2 PSI minimum. Electronic test gauges with digital readout and the capability to output data for recording purposes will also be accepted.

19.02 Transmission Line Testing (Operating at Hoop Stress of 30% or more of SMYS [192.505(a)])

- A. Test Pressure: The minimum test pressure will be 150% of the maximum operating pressure in Class 3 and 4 locations, and will be 125% of the maximum operating pressure in Class 1 and 2 locations. The maximum test pressure depends on the strength of the pipeline and the components in it. If water is the test medium, elevation must be considered.
- B. Test Medium: In Class 1 or Class 2 locations, if there is a building intended for human occupancy within 300 feet of a pipeline, a hydrostatic test is required (except as noted below) on the segment within 300 feet of such a building, but in no event may the test section be less than 600 feet unless the new or relocated pipe is less than 600 feet.

NOTE: Air or inert gas may be used if the building is evacuated while the hoop stress exceeds 50% of SMYS.

In Class 1 and Class 2 locations, the regulator station must be tested to at least Class 3 location requirements. [192.505(b)]

- C. Test Duration: The test pressure must be maintained for a minimum of eight hours in addition to the stabilization period. [192.505(c)]
- D. Fabricated Units and Short Sections: For fabricated units and short sections of pipe, where post installation test is impractical, pre-tested pipe shall be used. Pretested pipe must be pressure tested for at least four hours. [192.505(e)]
- E. Components Other Than Pipe: No test is required for components that are the only item being replaced if:

The component was tested to at least the pressure required for the pipeline to which it is being added, or the component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to the pressure required for the pipeline to which it is being added (fittings, valves, regulators, relief valves, etc.).

19.03 Gas Main Testing

All new or reinstated mains shall be pressure tested after backfilling but before being placed into service. Main shall be isolated from the existing system. Valves shall not be used to isolate or to hold test pressure. On tie-ins and appurtenances, where the air test is impractical, the test shall consist of soap testing all joints and fittings under operating pressure, provided pre-tested pipe is used (Section 16).

Mains to have an MAOP of 66 psig or less shall be pressure tested with air at 100 psig. Mains to have an MAOP greater than 66 psig, but operating at a hoop stress less than 30 percent of SMYS, shall be pressure tested to MAOP x 1.5 with air, inert gas, natural gas or water as approved by the Engineer. Mains to have an MAOP greater than 66 psig and capable of operating at pressures up to a hoop stress equal to 30 percent of SMYS shall be tested at a pressure equal to 30 percent SMYS with air, inert gas, natural gas, or water as approved by the Engineer. Test duration shall be in accordance with the following table, but in no case more than 24 hours for steel pipe or high density polyethylene pipe.

For medium density polyethylene pipe, the maximum test duration shall be 8 hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. Time to pressurize the test segment shall not exceed 48 minutes. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax at least 8 hours before pressurizing the test section again.

Table 19-1 Pressure Test Durations for Gas Main		
Size	Test Time Hours per 1000' *	Minimum Time
1"	1.0	-
2"	1.0	2.0
3"	2.0	3.0
4"	3.0	4.0
6"	4.0	4.0
8"	4.5	6.0
10"	9.0	8.0
12"	12.0	8.0
16"	24.0	8.0

* For MDPE pipe test durations requiring longer than 8 hours, a testing plan shall be approved by the engineer.

Mains requiring a test duration greater than 12 hours shall have a recording gauge monitoring the test.

Qualified department employee shall monitor and certify the test, showing initial and final time and pressures, date, and signature. Records of all pipelines operating at more than 100 psi will be retained for the life of the pipe.

19.04 Gas Services Testing

All new or reinstated gas services installed on live mains shall be pressure tested. Reconnected services are not required to be tested. Refer to Section 29 for the definition of reconnected service. Services shall be pressure tested individually and separate from the main or meter connection plumbing unless approved by Engineering. Before it is tapped, test shall include the riser, meter stop valve, and the attached service tee.

A repaired service must be pressure tested from the repair to the meter stop valve. Final joint at repair coupling may be soap tested.

Test gauge shall be installed on the outlet side of the opened meter stop valve.

All service lines shall be tested with air and accepted if it maintains 100 psig for the duration shown below:

Table 19-2 Pressure Test Durations for Gas Service		
Size	Test Time Hours per 1000'	Minimum Time
1/2"	0.5	0.5
1"	1.0	1.0
2"	1.0	2.0
3"	2.0	3.0
4"	2.0	4.0
6"	4.0	4.0

Accepted service can then be tapped to the main, the tap or punch tee cap soap tested, the service purged, and a threaded plug installed on the meter stop valve.

Service lines may be installed and tapped on PE mains not in service. Both main and service shall be tested to pressure and duration required for the main.

Mains not in service and to which services are to be connected and tested shall contain air pressure between 30 psi and 50 psi to enable a soap test of the tap or punch tee cap. Purging shall immediately follow or be done simultaneously with the main purging.

Each completed and purged service will have a pin type lock installed immediately by

Department personnel. Lock will be removed only by Department personnel or authorized personnel.

Qualified department employee or Utility Operations Leadworker shall monitor and certify the test, showing initial and final time and pressures, date, and signature.

19.05 Meter Set Testing

All meter sets shall be pressurized with air at 50 psi and submerged under water for one minute to inspect for leaks or tested for 30 minutes when not submerged. Meter sets may be pretested in a shop or field tested. Final connections shall be soap tested when placed into service.

Non-standard meter sets that are assembled in the field from 100% pre-tested components may be soap tested when completed and placed into service.

19.06 Fuel Line Testing

Where City personnel, or contractors working on behalf of the City, install fuel lines, the fuel lines shall be air tested at 1 and 1/2 times the operating pressure or 25 psi for 30 minutes except that fuel lines serving single family homes may have the test duration reduced to 10 minutes.

19.07 Test Records

All pressure test records shall be kept for the life of the facility +5 years. Document any leaks, failures, and their disposition, and any significant elevation variations on the applicable forms.

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SECTION 20: PURGING HP GAS PIPELINES AND SERVICES

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20.01 General

This section of the Standard Specifications establishes requirements and policies for purging HP gas pipelines, transmission mains and services.

20.02 Purging High Pressure Gas Mains and Services, gas to air and air to gas

Safety and Preventing Accidental Ignition

- A. Whether purging the line from air to gas or from gas to air, the purging material shall be introduced at a rate indicated in the purging table. If this rate cannot be achieved, then a slug of inert gas such as nitrogen must be introduced into the line before purging begins, to separate the gas and air.
- B. Before purging begins, all sources of potential ignition must be removed from the area, and a fire extinguisher must be on site and visible.
- C. Warning signs shall be posted where appropriate to caution or instruct others who are in or near the affected area.
- D. Dispatch (218-730-4150) shall be notified if a gas main is to be purged to the atmosphere in the downtown or other commercial area.

20.03 Distribution System

20.03.01 Purging 2" or larger Pipes

- A. Purging 2" and larger mains or services shall be by Department personnel or by the Contractor as directed by a Department inspector. Purge stacks at exit end of pipe are required.
- B. Purging of mains and services smaller than 2-inch shall be done by the Contractor.
- C. Entry and exit fittings and apparatus should not restrict flow velocity to less than 200 feet per minute through the purged pipe. The main shall not be purged through services with an EFV.

Table 20-1
Purge Venting

Pipe Size to be Purged	Volume (CFH) to obtain Vel of 200 FPM	*Max Length of ½" pipe if used to exit purge gas
2"	280	440'
3"	615	110'
4"	1060	35'
6"	2410	Engineer to Determine
8"	4325	Engineer to Determine
10"	6880	Engineer to Determine
12"	9825	Engineer to Determine
16"	15720	Engineer to Determine

*Based on 15 PSI min - inlet pressure

- D. Stack shall be a grounded metal stack, a minimum of one size smaller than the line being purged. Stack shall extend at least 6' above grade and be directed upward but angled away from wall if at a building.
- E. Person at purge location shall have visual or audio communication contact with person at control valve.
- F. Purging air to gas should be continuous at each purge point until a gascope indicates at least 85% pure gas. Where possible, valved branches should be turned off until that branch is purged. Any connected services also purged consecutively and without delay. On a system with several purge locations not isolated by valves, the highest ends shall be purged first.

Purging gas to air should be continuous until a mixture less than 10% LEL is measured at venting end.

20.03.02 Purging 1" or 1/2" Gas Services

Purging 1" or 1/2" gas services shall be done by the Contractor while under direct Department supervision.

20.04 Purging 10" Great Lakes Interconnect Transmission Line from Gas to Air

In general, the pressure in the transmission line should be reduced by closing the valves at the Great Lakes Custody Discharge Point (GLCDP) south of Oliver, Wisconsin, and letting the gas flow into the City of Duluth's distribution system through the Great Lakes Regulator Station (GL Reg Sta) in Gary New Duluth.

If there is an immediate hazard to human life, then the line should be isolated ASAP and the gas within the line should be vented to the atmosphere using the blowoff valves at either the GLCDP and/or GL Reg Sta. After the 10" pipeline has been isolated and the gas pressure reduced to near 0, it must be purged of all natural gas before work can begin on the 10" line. This line will be purged of all natural gas using the procedures as listed below.

- A. A drawing depicting the work shall be prepared that at a minimum includes the following:
 - 1. Work site and work to be performed
 - 2. Location of shut off points
 - 3. Area to be affected
- B. A coordination meeting must be held prior to purging the line to ensure all personnel understand the purging procedure.
- C. Items to be reviewed and/or coordinated at this meeting shall include the following:
 - 1. Finalizing date and time for purging to take place.
 - 2. Schedule notification of affected companies/agencies (Great Lakes Gas Transmission Company, City of Duluth PW&U, police and fire departments, etc.).
 - 3. Discuss the hazards involved, such as weather conditions, power lines, public highways, railroads and other obstructions.
 - 4. Notification schedule for houses near the GLCDP and GL Reg Sta.
 - 5. Any other items deemed necessary.
- D. Procedure for Purging Natural Gas from Line using Air Movers
 - 1. At least 2-20 lb. fire extinguishers shall be at the GLCDP and GL Reg Sta during the entire purging operation.
 - 2. Gas CGI's shall be recently calibrated and ready for use at the GLCDP and GL Reg Sta.
 - 3. The Operator will be responsible to ensure that no ignition sources are allowed in the work areas during purging operations.
 - 4. No flames, smoking, electric hand tools, or electrical equipment shall be used during purging operations.
 - 5. Do not purge any gas out of the line when an electrical storm is in the vicinity.
 - 6. Ensure all valves are in the closed position.
 - 7. Remove the blow off stack blind flange on 4" vertical valve #9738 at pig receiver.
 - 8. Install an air mover above the 4" vertical valve #9738 at the GL Reg Sta.
 - 9. Open the 4" vertical valve #9738 below the air mover and turn on the air mover.

10. Remove the blow off stack blind flange on 4" vertical valve #9736 at pig launcher.
11. Open the 4" vertical valve #9736 at pig launcher at the GLCDP. This is the inlet air supply for purging the line of natural gas.
12. Use a CGI at the outlet of the air mover to determine when all the gas has been purged from the main. No work can begin on the line until the gas has been completely purged.
13. The air movers must be continually staffed by personnel in contact with personnel performing work on the line.
14. The air movers must operate continuously until all welding has been completed.
15. Reduce the pressure settings on the air movers to reduce the vacuum on the pipeline to eliminate the blow-in of welds as the pipeline is closed to the atmosphere.
16. Once all work has been completed, the air mover can be removed.
17. Close 4" vertical valve #9724 at pig receiver. Reinstall 4" blind flange on blow off stack. Use a new gasket when reinstalling the blind flange.
18. Close 4" vertical valve #9738 at pig launcher. Reinstall 4" blind flange on blow off stack. Use a new gasket when reinstalling the blind flange.
19. Purge air from the pipeline in accordance with Section 13.03 and return it back into service.

20.05 Purging 10" Great Lakes Interconnect Transmission Line from Air to Gas

After all work on the transmission line has been completed, the pipe must be purged of all air before returning it to service. In general, the line will be purged from the Great Lakes Custody Discharge Point (GLCDP) south of Oliver, Wisconsin, to the City of Duluth's Great Lakes Regulator Station (GL Reg Sta) in Gary New Duluth. This line will be purged using the procedures as listed below.

- A. A drawing depicting the work shall be prepared that at a minimum includes the following:
 1. Work site and work to be performed
 2. Location of shut off points
 3. Area to be affected
- B. A coordination meeting must be held prior to purging the line to ensure all personnel understand the purging procedure.
- C. Items to be reviewed and/or coordinated at this meeting shall include the following:
 1. Finalizing date and time for purging to take place.

2. Schedule notification of affected companies/agencies (Great Lakes Gas Transmission Company, City of Duluth PW&U, police and fire departments, etc.).
3. Discuss the hazards involved, such as weather conditions, power lines, public highways, railroads and other obstructions.
4. Notification schedule for houses near the GLCDP and GL Reg Sta.
5. Any other items deemed necessary.

D. Procedure for Purging Air from Line

1. At least 2-20 lb. fire extinguishers shall be at the GLCDP and GL Reg Sta during the entire purging operation.
2. Gas CGI's shall be recently calibrated and ready for use at the GLCDP and GL Reg Sta.
3. The Operator will be responsible to ensure that no ignition sources are allowed in the work areas during purging operations.
4. No flames, smoking, electric hand tools, or electrical equipment shall be used during purging operations.
5. Ensure all valves are in the closed position.
6. Install a 0 to 100 psi pressure gauge near the GLCDP 10" pig launcher valve #9724 to be used for pressurizing the 10" line.
7. Remove the blow off stack blind flange on 4" vertical valve #9738 at pig receiver. Ensure stack is grounded.
8. Open the 4" vertical valve #9738 on pig receiver at GL Reg Sta.
9. To start purging, bring the inlet pressure at the GLCDP quickly to 12 psi using the 10" valve #9724 on the pig launcher. Maintain this pressure for 12 minutes.
10. At the end of the 12 minutes, turn off the 10" valve #9724 at the GLCDP.
11. Leave the 4" vertical valve #9738 on pig receiver at the GL Reg Sta open for an additional 6 minutes. Use a CGI to analyze the gas-air mixture throughout the purging operation and confirm that the gas is free of any air.
12. Close the 4" vertical valve #9738 on pig receiver at the GL Reg Sta.
13. Remove 0 to 100 psi gauge at pig launcher.
14. Open the valve at the GLCDP to load the pipeline at a controlled rate of 100 psi for the first hour.
15. After the pipeline has been pressurized to 100 psi, the loading rate can be increased @ 200 psi per hour.
16. Once the pressure has equalized on both sides of the valve, the 10" valve #9724 can be fully opened and the 10" pipeline can be placed back into service.
17. Reinstall the 4" blind flange on the blow off stack for valve #9738 on the pig receiver. Use a new gasket when reinstalling the blind flange.

20.06 Pigging Procedure for the 10" Great Lakes Interconnect Transmission Line

A. General Pigging Information

The City Engineering Division and Lake Superior Consulting developed the following pipeline pigging procedure for running cleaning pigs, gauge plate tools, caliper tools, and other smart pigging tools including MFL and IMU tools through the Great Lakes Interconnect Transmission Line beginning at the tap side on Irondale Road to the Great Lakes TBS. This procedure shall be approved for or modified by the Engineering Division prior to any pigging operations.

1. Additional safety precautions during pigging operations and purging of un-odorized gas:
 - a. Employees shall take additional precautions with FR clothing within the tool launcher and receiving areas.
 - b. Be prepared to test any pipeline debris removed from the receiver tube for NORM (Naturally Occurring Radioactive Material).
 - c. Cell phones and other non-intrinsically safe devices are not permitted within the launching and receiving areas, use of Department intrinsically safe 800 MHz radios is recommended.
 - d. Use only non-sparking tools within the launching and receiving areas during the procedure.
2. The City shall operate the transmission main during the pigging such that the tool speeds are generally maintained in the following ranges:
 - a. Cleaning tools: < 8 mph
 - b. Gauge plate and smart tools: 3-5 mph
 - i. Historically, a 500 MCFH gas flow rate would approximately produce a tool speed of 3 mph.
 - ii. Typical tool traveling duration from the launcher to the receiver should be between 2 and 3 hours.
3. Sequence and Procedure for Launching and Receiving Pigs
 - a. Overview
 - i. Sequence valves at Receiver Valve Site to receive pig
 - ii. Preparation at Launcher Valve Site to load pig
 - iii. Sequence valve to isolate and depressurize Launcher Barrel
 - iv. Load pig, secure closure, and pressurize Launcher Barrel
 - v. Sequence valves to launch pig
 - vi. Return valves at Launcher to "Normal Operation" position
 - vii. Gas Control to regulate flow to control speed of the pig during the run
 - viii. Tracking and Deployment/Retrieval of AGM's during pig run

- ix. Receive pig, sequence valves to isolate and depressurize Receiver Barrel
 - x. Preparation of Receiver and removal of pig
 - xi. Secure Receiver Closure
 - xii. Return ALL valves to “Normal Operation” position
- b. Refer to Exhibit 20-1 as the Pigging Procedure and Valve Sequencing – Pig Run Field Checklist.

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Exhibit 20-1

Pigging Procedure and Valve Sequencing – Pig Run Field Checklist

	CITY of DULUTH		
	LINE NAME: 10" NG Transmission		
	SEGMENT: GLGT VS to TBS		
	DATE of Run:		
	TYPE of Pig Run During This Procedure: FOAM Swab Pig: _____ POWER Brush Pig: _____ GAUGE Plate Pig: _____ CALIPER Pig: _____ MFL Pig: _____ EMAT Pig: _____ IMU Unit: _____ Take Pre and Post pictures of Pig		
	TAILGATE Meeting: YES NO N/A		
	Please attach a copy of the TAILGATE Meeting to this document		
	CITY of DULUTH Contact Names	Phone	Number
1			
2			
3			
4			
	CONTRACTORs Contact Names and Company Name	Phone	Number
1			
2			
3			
4			
5			
Team	PIG TRACKERS	Phone	Number
A			
B			
C			
	Weather:	Temp:	

USE PAGES 10 – 17 for Each Pig Run (No AGM Tracking)

USE PAGES 10 – 20 for Each Pig Run When AGM Tracking

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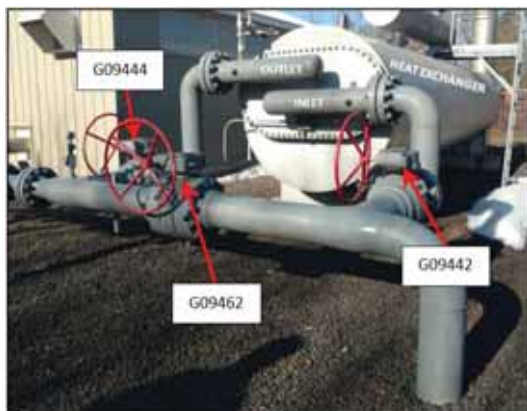
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LAUNCH and RECEIVE PROCEDURE Steps

Step	Action	Initial	Time
	At the RECEIVER SITE (City of Duluth Town Border Station)		
PRE	IF this pig run includes using AGMs (Above Ground Markers), the Pig Trackers will verify that the units are working and complete the form in Appendix 1 – Pages 18-19		



1	OPEN Valve G09436 (4" ByPass Valve)		
2	OPEN Valve G09434 (10" Receiver Valve)		
3	CLOSE Valve G09438 by 50% (10" Main Line Valve)		



4	OPEN 8" Valve – G09442		
5	OPEN 8" Valve – G09444		
6	CLOSE 8" Valve – G-09462		
7	OPEN 6" Valve – G13466		
8	CLOSE 3" Valve – G-13444		
10	FLOW is through the 6" Strainer to the Meter Run Building		

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SECTION 20: PURGING HP GAS PIPELINES AND SERVICES

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Step	Action	Initial	Time
	At the LAUNCHER SITE (GLGT Valve Station)		
PRE	IF this is an ILI tool run, the tool vendor will have the tool in the “Run Mode” prior to opening the launcher closure.		
PRE	PRIOR to loading the ILI tool into the launcher, complete the Function Checklist in Appendix 2 - Page 20		
PRE	INSTALL Air Mover unit onto Valve G-LVV-2 (1” Vent Valve)		



1	CLOSE Valve G09726 / LOTO (4” Kicker Valve)		
2	CLOSE Valve G09728 / LOTO (10” Launcher Valve)		
3	OPEN Valve G-LEV-2 (1” Reducer Equalization Valve)		
4	 POSITION Personnel with Gas Detectors to Monitor for Air Quality as discussed during the Pre-Job meeting		

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Step	Action	Initial	Time
5	START Air Mover and Slowly open valve G-LVV-2 to Depressurize Launcher Barrel		
6	Leave Air Move running		
7	Do not operate door closure until 0.0 PSI has been confirmed in barrel		
8	LOOSEN the pressure interlocks on the closure door		
	 		
9	OPEN Launcher Closure – Look inside launcher for debris		
	IF this is the ILI tool run, the tool vendor will have bonding cables to bond the tool and transport tray to the launcher		
11	Load pig until front of pig is seated into nominal pipe past the reducer		
12	If pig has a transmitter, use a receiver unit to locate front of pig If pig has no locator, use tape measure to locate front of tool		
13	Service closure based on operating company manual (New O-ring, cleaning, lubrication.... Etc.)		
14	Secure Launcher Closure		
15	CLOSE Valve G-LVV-2 (1" Vent Valve)		
16	STOP Air Mover		
17	Remove LOTO from Valve G09726 (4" Kicker Valve)		
18	Remove LOTO from Valve G09728 (10" Launcher Valve)		
19	SLOWLY Open Valve G09726 and bring the pressure in the launcher up to mainline pressure – make sure not to move pig		
20	FULLY OPEN Valve G09726 (4" Kicker Valve)		
21	IF tool is equipped with a Transmitter, have Pig Tracker confirm that it is operational before launching		
22	Communicate with key personnel pig is ready to launch i.e. Pig Trackers, Gas Control, Station Operators		
23	OPEN Valve G09728 (10" Launcher Valve)		
24	CLOSE Valve G-LEV-1 (1" Reducer Equalization Valve)		
25	START to Close Valve G09724 and listen for pig to leave launcher		
26	Communicate with key personnel pig has launched i.e. Pig Trackers, Gas Control, Station Operators		

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SECTION 20: PURGING HP GAS PIPELINES AND SERVICES

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Step	Action	Initial	Time
27	PIG LAUNCH TIME:		
28	Contact GAS Control for: Flow Rate: _____ Pressure: _____ @ Launcher		
29	OPEN and Lock Valve G09724 – Gas Control Will Control Pig Speed		
30	CLOSE and Lock Valve G09726 – (4” Kicker Valve)		
31	CLOSE and Lock Valve G09728 – (10” Launcher Valve)		
32	REMOVE Air Mover from Valve G-LVV-2 (1” Vent Valve)		
33	RECORD the passage time at each AGM site, relay Pig Speed to Gas Control to maintain a pig tool speed for the type of pig being run FOAM Pig: < 8 mph - GAUGE/BRUSH Pig: 3-5 mph - MFL/CALIPER/EMAT Pig: 3-5 mph		
AGM #	PASSAGE TIME (Hrs:Min:Sec)	Distance From Start (Miles)	CoD STATION # (Feet)
LAUNCHER VALVE		0.00	1+40.76
AGM 1		0.03	3+11.45
AGM 1A		0.45	25+39.00
AGM 2		0.83	45+42.97
AGM 3		1.13	71+74.03
AGM 3A		1.64	88+00.00
AGM 4		1.95	104+23.20
AGM 5		2.16	115+54.53
AGM 5A		2.49	132+97.00
AGM 6		2.82	150+26.16
AGM 6A		3.28	174+35.00
AGM 7		3.77	200+38.84
AGM 7A		4.13	219+29.00
AGM 8		4.15	220+46.18
AGM 9		4.39	233+23.65
AGM 11		5.13	272+33.02
RECEIVER VALVE		5.28	280+12.00

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SECTION 20: PURGING HP GAS PIPELINES AND SERVICES

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Step	Action	Initial	Time
	At the RECEIVER SITE (City of Duluth Town Border Station)		
PRE	Install Air Mover onto Valve G-RVV-2 (1" Vent Valve)		



1	PIG RECIEVE TIME:		
	IF pig stops prior to Valve G09434 (10" Receiver Valve)		
2	Start to CLOSE Valve G09438 (10" Mainline Valve) Listen for pig to move into oversize section of trap		
3	OPEN Valve G09438 (10" Main Line Valve)		
4	CLOSE Valve G09436 / LOTO (4" ByPass Valve)		
5	CLOSE Valve G09434 / LOTO (10" Receiver Valve)		
6	SHUTDOWN Heat Exchanger Unit until closure has been secured		
7	 POSITION Personnel with Gas Detectors to Monitor for Air Quality as discussed during the Pre-Job meeting		
8	START Air Mover and Slowly open valve G-RVV-2 to Depressurize Launcher Barrel		
9	Leave Air Move running		
10	Do not operate door closure until 0.0 PSI has been confirmed in barrel		

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Step	Action	Initial	Time
11	LOOSEN the pressure interlocks on the closure door		
	 		
	IF this is the ILI tool run, the tool vendor will have bonding cables to bond the tool and transport tray to the receiver		
12	REMOVE pig ➤ Cleaning pigs to be placed in appropriate containers for disposal ➤ Gauge plate pig to be cleaned, gauge plate removed and photos with measurements will be sent to ILI vendor ➤ ILI Tool to be placed on transport tray and moved onto the vendors truck to be taken for data download/cleaning		
13	Check receiver for debris left behind pig		
14	Service closure based on operating company manual (New O-ring, cleaning, lubrication.... Etc.)		
15	SECURE Receiver Closure		
16	CLOSE Valve G-RVV-2 (1" Vent Valve)		
17	REMOVE all LOTO Tags from Valves		
18	LEAVE Locks on Valves: G09436 (4" ByPass Valve) G09434 (10" Receiver Valve)		
19	START Heat Exchanger Unit		
20	VERIFY ALL Valves at the Launcher and Receiver Sites are in the "Normal Operating" Position		
21	REMOVE Air Mover from Valve G-RVV-2 (1" Receiver Vent Valve)		
22	PROPERLY dispose of any debris from the pig run		
23	COMPLETE Tool Function Checklist – Appendix 2		

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APPENDIX 1 – AGM UNIT FUNCTION CHECKLIST

Unit Function Checklist

Date: _____

AGM	Serial #	STATUS	AGM	Serial #	STATUS
1			16		
2			17		
3			18		
4			19		
5			20		
6			21		
7			22		
8			23		
9			24		
10			25		
11			26		
12			27		
13			28		
14			29		
15			30		

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Transmitter Function Checklist

Txmitter #	Manufacture	Serial #	Pulse	Steady	START Time	Comments
1						
2						
WAS Transmitter(s) Checked Just Before Launching?			YES	NO		
WAS Pig Equipped with Magnets Only?			YES	NO		

Tracking Receiver Function Checklist

Receiver #	Manufacture	Serial #	MAG Only	TX Only	Both	Comments
1						
2						
3						
4						

GeoPhone Function Checklist

GeoPhone #	Manufacture	Serial #	Comments
1			
2			
3			
4			
5			
6			
7			

Run Date:		Type of Pig Tracked: CLEANING - GAUGE - CALIPER - MFL	Prepared By:

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SECTION 20: PURGING HP GAS PIPELINES AND SERVICES

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APPENDIX 2 – CALIPER AND/OR MFL TOOL FUNCTION CHECKLIST

TOOL COMPONENT	Pre-Run	Post Run	# of Bad Sensors	Comments
Main ML Sensors				
Internal ML Sensors				
Caliper Sensors				

TOOL COMPONENT	Pre-Run	Post Run	Comments
Odometers #1			
Odometers #2			
Odometers #3			
Locate Transmitter			
IMU (Internal Mapping Unit)			
Cleanliness of ILI Tool	N/A		
Damage to ILI Tool	N/A		

ATTACH PHOTOS of CALIPER or ILI TOOL DAMAGE

Prepared By:	Print:	Sign:	Date:

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SECTION 21: ABANDONING GAS PIPELINES

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SECTION 21: ABANDONING GAS PIPELINES

Page 1

21.01 General

This section of the Standard Specifications establishes requirements and policies for abandoning existing gas pipelines and services.

21.02 Abandoning Transmission Lines

Any transmission pipeline abandoned in place will require a procedure prepared by Engineering prior to any work. Each transmission line section abandoned in place must be physically disconnected from all sources of gas supply.

Any transmission line section abandoned shall be purged of gas following the procedures outlined in Section 20.02, Purging High Pressure Gas Mains & Services.

Purge shall continue until a mixture less than **10% LEL** is measured at vented end.

The Department will provide labor and materials to seal any end still connected to a gas source using standard welded end caps or blind flanges.

21.03 Abandoning Gas Mains

Each pipeline abandoned in place must be physically disconnected from all sources of gas supply. Any main being abandoned which is 2" or larger and a length of 50 feet or longer shall be purged of gas following the procedures outlined in Section 20.02, Purging High Pressure Gas Mains & Services.

Purge shall continue until a mixture less than **10% LEL** is measured at vented end. Mains specified on the Plan to be abandoned shall be abandoned in place except where noted otherwise. The Contractor shall effect the cutoffs where the main is steel or plastic and has been depressurized and purged, if necessary.

The Department or Contractor will provide labor and materials to seal any end still connected to a gas source using standard fuse or welded end caps.

Openings at ends which have been disconnected from any gas source shall be sealed either by Department or Contractor as follows:

2"+ Steel Mains	by weld-on plate, coupling and end cap, blind flange, injected polyurethane foam, fernco cap, or concrete
2"+ Plastic Mains	by fused end cap or injected polyurethane foam
Cast Iron Mains	by M.J. cap, M.J. coupling & plug, tamp on plastic pipe plug, fernco cap (previously injected sealant foam or concrete abandoned)

When removing sections of the previously abandoned low-pressure cast iron gas system, it is necessary to provide at least a 1" Type K copper or PE jumper drain to allow the abandoned system to continue draining freely. The Engineering Division may provide exemptions to this requirement, with alternative directions in areas where the old abandoned low-pressure gas system is on level terrain or the length of the jumper drain becomes excessive.

Injected sealant foam shall be closed cell type. Open cell foam shall not be allowed.

21.04 Abandoning Services (Cut off at main)

Any abandoned service must be disconnected from gas source and depressurized. Purging of gas is required if service is 1" or larger and longer than 50 feet. When purging a service, the same procedure as purging abandoned main (Section 21.02) shall be followed.

- A. P.E. Services (1/2" & 1" with P.E. Service Tees). Turn down self-tap cutter, soap and reinstall cap, cut service and attach short capped 1/2" stub with mechanical fitting or fuse-on P.E. cap as close to service tee as practical.
- B. P.E. Services (2" with P.E. High Volume Tapping Tees). Turn down self-tap cutter, soap and reinstall cap, cut service and attach short capped stub with mechanical fitting or fuse-on P.E. cap as close to service tee as practical.
- C. 1/2" P.E. or 5/8" Service with steel tap tee. Turn down self-tap cutter in mini-tee, reinstall cap, remove extrude steel service, insert short capped $\pm$ " P.E. stub in compression fitting and retighten nut to seal. P.E. stub must have stiffener installed.
- D. P.E. Services (2" & 3" with Tee or branch saddle off P.E. main). Squeeze off service and fuse on end cap as close to main tee as practical. If a P.E. Service valve is too close to main, then shut valve, install end cap just downstream, and do not replace box.
- E. Steel Service (1-1/4", 1-1/2" & 2"). Connected to main with weld on No-Blo tee. Remove cap, insert rubber stopper using machine, cut off service, weld a sized steel slug in end, reinstall completion plug and cap.
- F. Steel Service (2" & larger which have no tap valve or No-Blo tee). Stopple service as close to main as possible; weld on end cap.

21.05 Partially Abandoning Services (Cut off at service valve)

Steel Service (2" & larger which have tapping valve at main). Shut off service valve, install blind flange on valve, **do not** replace box. If valve is a plug type, it must be

lubricated before burying. Record to remain in active service file and noted as "cut off at valve."

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SECTION 22: INSTALLATION OF SERVICE METER CONNECTIONS

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22.01 General

This section of the Standard Specifications establishes requirements and policies for the installation of service meter connections.

22.02 General Requirements

This work consists of plumbing in gas piping less than 2 inches in diameter above the outside meter stop valve, installing the regulator, meter, and inside stop valve. Plumbing shall conform to Section 2200, Uniform Mechanical Code, with Chapter 1346 MN Amendments, the National Fuel Line Code, as applicable, the Detail Drawings, and the following requirements.

General provisions for installing meters and regulators are contained in Section 30 and in the following provisions.

- A. When relocating meters from inside to outside, buildings having 1 or 2 inside meters shall have the new meters installed outside. Buildings with 3 or more inside meters will have the new meters installed inside, unless otherwise specified.
- B. Piping shall be extended from inside stop valve to existing gas piping, and piping shall be restored or removed, as necessary, where meters were removed.
- C. Abandon any unused underground service piping in accordance with Section 21.

A schedule of connections will be provided.

The Department shall furnish the following materials to Contractor, who shall pick them up from 520 Garfield Avenue:

Service regulator, meter and meter bar or meter mounting bracket, test plugs, or relief devices, as may be required.

All other materials shall be furnished by the Contractor, including:

Gas pipe for plumbing shall be black iron or steel, conforming to Section 14.02.02. Fittings shall be threaded black iron or steel.

Pipe shall not be less than 1" between regulator and small meters whether single or duplex.

Inside Stop and other materials incidental for the installation.

Outside threads of all pipe and fittings shall be doped with Gasoila or Teflon tape.

Prior to installing meters, the meter swivel threads shall be lubricated with "Permatex Anti-Seize" or a similar approved compound.

Pipe supports shall be installed as required to adequately support all piping.

All piping, fittings, valves, and brackets outside of the building shall be cleaned of oil, dirt, scale, and primed with Rust-Oleum Primer #678 or #769, Rustex or DeRusto. Color shall be gray. Spray painting is not permitted. Paint shall be brushed on after the pipes are wiped with a cloth wet with oil cutting solvent.

Removed piping shall be disposed of according to the wishes of the building owner.

One Pete's Plug or equivalent shall be located on the high pressure side of the regulator and a second shall be located on the low pressure side of the regulator on any meter larger than 415,000 BTUs unless approved by the Measurement Services Supervisor.

22.03 Valve Requirements for Gas Meter Connections

- A. Inside shutoffs. Each service entering a building must have a lever-operated valve at a convenient location and as close to the entry location as possible. Valves shall be ball type as specified in Department Standard Specifications. Approved lever handle plug type may be used for larger sizes.
- B. Meter Stop Valves. Each meter shall have an independent shutoff valve capable of being locked in a closed position with a 1/2" pin type lock. Single or master meter stop (3/4" and 1") are specified in Section 14.04.05. Valves for multiple meter stops shall be as specified in Section 14.04.07, and be tamper-proof, lock-wing type, suitable for locking in a closed position.

Department personnel will immediately install a pin lock on each closed meter stop following installation, testing, and purging of a new gas service. The pin lock shall be removed by Department personnel or Department-authorized person only when testing meter connection work and for light-up purposes.

GAS OPERATION & MAINTENANCE MANUAL
SECTION 25: INSTALLATION OF CATHODIC PROTECTION MATERIALS

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25.01 General

This section of the Standard Specifications establishes requirements and policies for the installation of cathodic protection materials.

25.02 Anode Installation

For the protection of steel mains, anodes shall be placed as shown in the Detail Drawing. The backfill immediately surrounding the anode must be saturated with a pail of water before finishing the backfill. Wires shall have slack and be hand backfilled.

25.03 Insulator Installation

- A. Casing Insulator Installation. Casing insulators shall be installed between steel carrier pipes and steel casings. Insulators shall conform to Section 14.06.03. Insulators shall be spaced at intervals between 10 and 15 feet and not farther than 2 feet from the ends.
- B. Pipe Support Insulator Installation.

Installation of Glas Mesh Type 180 or Type 240 Pipe Saddles

All defective coating, loose paint, rust, and corrosion products to be removed under the proposed pipe saddle or casing insulator. Surface to be free of moisture, grease and oil. The surface may be painted or taped to match the color of the pipe prior to the installation of pipe saddle. For the pipe saddles type 180 or 240 must be attached to the pipe with seam sealer and all exposed edges to be beveled. This is to prevent moisture entrance into the saddle.

Installation of the Glas Mesh Type 220/240 Casing Insulator

The type 240 (larger of the two) shall be installed on the bottom of the pipe and the type 220 on top and overlapping the type 240. Both of these insulators must be installed with seam seal, all voids must be filled so that moisture can not enter either insulator.

25.04 Test Stations

Test Stations shall be installed at locations indicated on the Plans, according to the Standard Detail Drawing. Box shall be plastic, as specified in Section 14.06.02.

For installations in areas subject to vehicular traffic, where it is impractical to locate the box outside the pavement, the plastic box shall be set in the top section of a CI valve box. When installation is intended to be on poles or other structures, such will be noted on the Plans.

Test Stations located at valves shall have the test box placed adjacent to the valve box.

Each test lead wire must be connected to the pipeline so as to remain mechanically secure and electrically conductive. Each test lead wire must be attached to the pipeline so as to minimize stress concentration on the pipe. Each bared test lead wire and bared metallic area at point of connection to the pipeline must be coated with an electrical insulating material compatible with the pipe coating and the insulation on the wire. (See Standard Drawing G-18)

Before any new test lead is connected to the transmission line, the pressure in the line must be reduced such that it is below 20% SMYS on the line.

25.05 Field Coating Application (Below Grade)

Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must:

- A. Be applied on a properly prepared surface;
- B. Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;
- C. Be sufficiently ductile to resist cracking;
- D. Have sufficient strength to resist damage due to handling and soil stress; and,
- E. Have properties compatible with any supplemental cathodic protection.

Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.

If coating pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

Coating materials specified in Section 14.06 shall be applied to all uncoated portions of pipe, fittings, valves, including bolts, couplings, damaged coatings, and other related steel components of the gas system. Casing pipes do not require coatings.

Field coating for underground pipeline shall be applied as follows:

TC Mastic or wax tape by Trenton, Denso, or approved equal shall be applied to mechanical bolt-type couplings, flanges and flanged fittings, no-blo tees, tapping saddles, and other irregular shaped fittings.

Scotchkote Liquid Epoxy 323, Liquid Epoxy 328, or Denso Protal 7125 may be applied to below grade steel pipe, valve, fittings, tees, etc. with surface preparation meeting SSPC-SP10 or NACE-2.

All valves shall be field coated regardless of existing factory applied coatings.

Cold tapes -- Weld joints, weld fittings, and coating repair

Optional hot-type applications shall be as follows:

Shrink Sleeves - weld joints and boltless compression couplings

Tapecoat 20 - weld joints, weld fittings, and coating repair

Directional bore pipe shrink sleeves, Dirax by Raychem

Coating shall be applied to dry, clean and primed surfaces.

Primer must be the companion to the manufacturer's coating.

Bitumastic type coatings shall not be backfilled for 16 hours after application to allow for cure time.

Tape shall be installed in accordance with the manufacturer's recommendations and shall overlap 1/2 inch for spiral method of wrapping and 1 inch for the cigarette method.

Holidays over two square inches shall be repaired by wrapping tape completely around the pipe.

Holidays less than two square inches in the epoxy pipe coating may be repaired using hot melt patch sticks, Scotchkote 226P or equivalent. Hot melt patch sticks shall be applied as follows:

1. Roughen the surface of the parent fusion bonded epoxy (FBE) coating using 80-mesh to 120-mesh sandpaper. Clean the surface and wipe away the sanding residue with a non-contaminating cloth.
2. Preheat the parent-coating surface using a non-contaminating heat source, such as portable hand-held butane torch. Heat should be applied in a manner that avoids burning or charring of the epoxy coating. Slight browning of the parent coating is acceptable, but charring or blistering is not. Avoid heat application directly to the patch stick while pre-warming the coating surface.

3. While continuing to heat the FBE surface, occasionally draw the patch stick across the repair area until it leaves a residue. Then rub the stick in a circular motion and utilize the torch to help melt it and maintain the pipe coating temperature. Continue until the patch is smooth and has a thickness of at least 15 mils (380 microns) greater than the parent coating.
4. Allow the patch to cool before handling.

25.06 Field Coating Applications (Above Grade)

General Applications	System			
	Top Coat	Primer	Prep.	Applic.
A. New Meter Connections, New outdoor fuel pipe	None Required	Rust-oleum #678 or 769 14.06.05A	SSPC-SP1 & SSPC-SP2	Brush
B. Regulator Stations	Pitthane two-part Urethane Gray	Dupont Vari Prime-Green (acid base)	SSPC-SP1 & SSPC-SP2	Brush or Spray
C. Meter Set Piping Recoating Program	Polymide Epoxy 14.06.05B 5-8 Mills	None Required	SSPC-SP2	Brush
D. New Uncoated gas mains, fittings, on creek crossings, bridges, etc.	Acrylic-Urethane Enamel 14.06.05C	Inorganic zinc-rich primer 3 Mills	SSPC-SP10 Or NACE #2	Spray or Brush
E. Previously painted mains, fittings on creek crossings, bridges, etc.	Acrylic-Urethane Enamel 14.06.05C	Organic zinc-rich primer 3 Mills	SSPC-SP6 Or NACE #3	Spray or Brush
F. Previous coal tar, 3M or X-TRU, coated mains on creek crossings, bridges, soil to air interfaces, etc.	Tapecoat, wax tape, & Aluminized Mastic 14.06.05D	TC Omni Prime, Wax Tape None Required for Mastic	SSPC-PC7 Or NACE #4	Machine or hand, mastic is brushed

25.07 Surface Preparation

Painting or coating systems will require one of the following surface preparations. Specs referred to are Steel Structures Painting Manual.

SSPC-SP1 - Solvent cleaning. Oil to be removed with solvent and brush or wipe cloth.

SSPC-SP2 - Hand tool cleaning with wire brush as necessary to remove loose paint, loose rust, dirt, and pipe tape.

SSPC-SP5 or NACE-1 - White Metal Blast Cleaning

Completely remove all mill scale, rust, rust scale, previous coating, etc., leaving the surface a uniform gray-white color.

SSPC-SP10 or NACE-2 - Near White Blast Cleaning

Remove all blast scale, mill scale, previous coating, etc., leaving only light stains from rust, mill scale, and small specks of previous coating. At least 95% of each square inch of surface area is to be free of all visible residues, and the remainder shall be limited to slight coloration.

SSPC-SP6 or NACE-3 - Commercial Grade Blast Cleaning

Completely remove all dirt, rust scale, foreign matter, and previous coating, etc., leaving only shadows and/or streaks caused by rust stain and mill scale oxides. At least 66% of each square inch of surface area is to be free of all visible residues, except slight discoloration.

SSPC-SP7 or NACE-4 - Brush-Off Blast Cleaning

Remove rust scale, loose mill scale, loose rust, and loose coatings, leaving tightly bonded mill scale, rust, and previous coatings. This is an ideal method for removing oxides and/or loose and peeling coatings from galvanized metal. Results are comparable to those achieved through chipping, scraping, and wire brushing. In all cases of surface preparation, the surface must be primed within 6-8 hours of abrasive blasting.

**SECTION 26: MEASUREMENT AND PAYMENT FOR HIGH PRESSURE GAS
PIPELINES**

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SECTION 26: MEASUREMENT AND PAYMENT FOR HIGH PRESSURE GAS PIPELINES

26.01 Method of Measurement

All items will be measured separately according to design designation as indicated in the Pay Item name and as may be detailed and defined in the Plans or Special Provisions. Pipe will generally be designated by size and kind or type. Complete-in-Place items shall include all component parts thereof as described or required to complete the unit, but excluding any excesses covered by separate Pay Item.

26.01.01 Gas Pipe.

Gas main pipe of each kind and size will be measured separately by the overall length along the center of the pipeline from the beginning of each installation and without regard to intervening valves, casings, couplings, transitions of other material or sizes, or minor line deviations caused by slack in laying coiled pipe. Terminal points of measure will be to the physical ends of the pipeline, to the centerline of in-place connecting pipelines. Bend and ties shall be included and measured from intersecting centerlines. Reducers, where transition is not abrupt, shall be measured as the larger size pipe.

Gas service pipe will be measured as the ground distance from the center of tapping tee, (or gas main for large services) to the point where the riser comes out of the ground.

All costs of installing gas main placed by horizontal directional drilling between the locations shown on the plans or as directed by the Engineer; including gas main pipe, appurtenances, locating wire, and testing; shall be paid for at the contract unit price per linear foot for Install (diameter, PE or steel) Gas Main by Horizontal Directional Drill. If the Contractor chooses at his option to horizontally directional drill gas main not shown on the plans or designated by the Engineer for horizontally directional drilling, payment shall be made at the contract unit price per linear foot for Install (diameter, PE or steel) Gas Main.

26.01.02 Service Meter Connections.

Measurement shall be made on the basis of one (1) connection per meter, except when connection is to multiple meters which are not replaced or relocated, in which case measurement will be one connection regardless of the number of meters. Multiple meters, which are replaced or relocated, will be measured as one (1) connection per meter.

Multiple meters all less than 400, if replaced or relocated, and requiring a B-31 regulator or larger, shall be paid for as one connection, greater than or equal to 400 for the first meter and less than 400 for the rest.

Removed meters which are piped through or capped off shall be paid for at one-half (1/2) the respective meter connection bid price.

SECTION 26: MEASUREMENT AND PAYMENT FOR HIGH PRESSURE GAS PIPELINES

Meter Connections will be paid for by size accordance to the meter rated capacity as follows:

- Meter Connections (less than 400 CFH)
- Meter Connections (400 CFH and larger)

26.01.03 Excavation for Cutoffs, Regulator Station, Relief & Miscellaneous.

Excavations designated on the Plans and as a unit item in the proposal on a per each basis will be measured separately for each such excavation completed, including backfill and required surface restoration. This item shall be measured for payment only to the extent that the excavation does not lie in a location already requiring excavation for construction of other items for which excavation is included.

26.02 Basis of Payment

Payments for gas mains and related facilities will only be made under the items in the proposal. Cost of other work necessary to complete in place the improvements required on the Plans and in the Contract Documents will be considered incidental and the costs included in the unit items unless it qualifies as extra work and is properly authorized.

Payment for gas main and gas services shall be compensated in full for all costs of furnishing and installing the pipe complete in place as specified, with the exception of rock excavation, granular borrow material not specified as a Laying Condition, and casing pipes where separate payment is established, but including all costs of pipeline installation not exempt by a pay item or authorized extra. Incidental pipeline cost shall include, but not be limited to, furnishing and installing all required materials for the pipeline (unless specified to be furnished or installed by the Department) including valves, couplings, insulators, locating wires, continuity wires, test stations, anodes, field coatings, joining, fittings, testing, excavation, backfill, surface restoration as may be required. Cost of services shall include the connection to main, riser, meter stop, plug, beside the same applicable incidentals required for gas main.

Payment for service meter connections shall be on a unit price basis and shall include full compensation for all materials, labor, equipment necessary to install the regulator, meter, inside stop valve and interconnecting plumbing from the meter stop valve to the inside stop valve or existing plumbing where such plumbing exists. Meters requiring removal only will be paid for at one-half the bid price for meter connections.

Payment for excavations for cutoffs, regulator stations, system reliefs or miscellaneous shall include all labor and materials not specifically furnished or installed by the Department.

**SECTION 26: MEASUREMENT AND PAYMENT FOR HIGH PRESSURE GAS
PIPELINES**

Payment for items which are eligible for compensation will generally be made on the basis of the following schedule. Consult the proposal for actual payment items for this project.

<u>Item Name</u>	<u>Unit</u>
Gas Main (Size and Type)	Linear Foot
Gas Service (Size and Type)	Linear Foot
Service Meter Connection (Size)	Each
Excavation for (Cutoffs, Regulator Station, Reliefs, Miscellaneous)	Each
Valve Boxes	Each
Reconnect Services	Each

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27.01 General

Welding of joints and connections for gas pipelines shall only be done by welders qualified in accordance with the requirements of this section.

Upon request by the inspector or at any time before beginning production welding, a contractor must submit documentation of welder's qualifications in accordance with API 1104 Nineteenth Edition, on a form similar to the API Welder Qualification Coupon Test Report as shown in Figure 27-1. Documentation may be submitted to Duluth Public Works and Utilities Department, Engineering Division, 411 West 1st Street, Duluth, MN, 55802.

Department welders must be qualified in the same manner as contract welders.

27.02 Qualification Procedure

- A. The Department has established general specifications for single V butt welds (DPWU-1 and DPWU-6), single bevel branch connections (DPWU-2), and fillet welds (DPWU-3). These general specifications are implemented through specific Welding Procedure Specifications (WPSs) which meet the Essential Variable requirements of API 1104 Nineteenth Edition. Welder Qualification Tests must be set up and performed within the parameters of the specified WPSs which are provided in Welding Procedure Manual.
- B. A welder must be qualified by an independent testing company, the name of which is to be indicated on the qualification document.
- C. Qualification document must be the same or similar to the form shown in Figure 27-1, the API Welder Qualification Coupon Test Report.
- D. Testing company shall evaluate test welds in accordance with API 1104 Nineteenth Edition, Section 6 or Section 9 (based upon if the test is for initial qualification [Section 6] or requalification [Section 9]) for butt welds, branch connections, or fillet welds as required by the specific project they are working on. Department welders will perform the Multiple Qualification test as outlined in API 1104 Nineteenth Edition Section 6.3. If contract welders need to qualify on fillet welds, they must be qualified in the same manner (API 1104 Section 6.3).

27.03 General Welding Specifications

27.03.01 Shielded Metal Arc Welding (SMAW) Butt Welding General Specification

A. Reference

API 1104, Nineteenth Edition

City of Duluth Procedure DPWU-1, DPWU-18, DPWU-19

B. Process

Welding shall utilize the Shielded Metal Arc Welding (SMAW) process.

C. Base Metals

Pipe welded according to this standard shall include ASTM A53, API 5L Grade B, and API 5L X42 through X-60. Pipe 2 NPS and smaller shall be limited to ASTM A53, API 5L Grade B or equivalent.

D. Diameter and Wall Thickness

This standard shall apply to pipe having a diameter equal to and larger than 2 NPS through 16 NPS. The wall thickness shall be equal to and larger than 0.154 inch up to and including 0.750 inch.

E. Joint Design

The joint ends shall be beveled to an angle of 30°, +5°, -0°, with a root face of 1\16", $\pm 1\32$ ". Bevels shall form a "V" groove with an included angle of 60°. The root opening shall be 1\16", $\pm 1\32$ ". This applies to both circumferential butt joints and sleeve side seam joints. For sleeves, the end preparation shall be with as little space between the sleeve and pipe as possible.

F. Filler Metal

The filler material shall conform to AWS A5.1, E6010, Group F-3 (ASME) Weld Analysis A-1 for the first pass (root) and AWS A5.5, E8010-G, Group F-3 (ASME) Weld Analysis A-1 for subsequent passes (hot pass, filler and cap).

G. Size of Electrodes and Number of Beads

Wall Thickness (inches)	Stringer Bead E6010	Hot Pass E8010-G	Fill and Cap E8010-G
< 0.188	3/32"	3/32"	1/8"
0.188 - 0.750	1/8" - 5/32"	1/8" - 3/16"	1/8" - 3/16"

The minimum number of passes is dependent on wall thickness but shall not be less than 3 passes with no pass deposited thicker than 1/8".

H. Electrical Characteristics

The welding current shall be D.C. current, Reverse Polarity (electrode positive).

Electrode	Rod Diameter	Amperage	Voltage
E6010	3/32"	60 - 100	20 - 26
E6010	1/8"	75 - 130	20 - 27
E6010	5/32"	90 - 170	20 - 27
E8010-G	3/32"	60 - 100	20 - 26
E8010-G	1/8"	75 - 130	20 - 27
E8010-G	5/32"	90 - 170	24 - 27
E8010-G	3/16"	140 - 190	24 - 27

I. Direction of Welding

Welding shall progress downward from top or any point on the side of the pipe to bottom center.

J. Speed of Travel

The speed of travel should be within the range of 3 - 14 inches per minute.

K. Number of Welders

When the nominal pipe diameter is less than 16", one welder may be used to run the stringer bead (root bead). When the nominal pipe diameter is 16" or greater, two welders will be required to run the stringer bead and hot pass.

L. Time Lapse Between Passes

The second pass (hot pass) shall follow the stringer bead (root bead) within five minutes. Subsequent passes shall be initiated within five minutes of the completion of the previous pass. A minimum of 3 passes shall be completed before the end of the day. Any weld that is not finished the day it is started shall be finished the next workday.

M. Type of Line-up Clamp

Fabrication, Maintenance, and Tie-in welding: External line-up clamps should be used on all sizes of welds. Sleeves, chains, clamps, hydraulic jacks or other similar

mechanical holding devices shall be used to hold the sleeve in intimate contact with the pipe before welding starts.

N. Removal of Line-up Clamp

On 16" or larger diameter pipe, the line-up clamp shall remain in place until 100% of stringer bead (root bead) is completed. The department may reduce said percentage if, in its sole judgment, acceptable welds can be produced at that reduced percentage. However, the department retains the right to require the contractor to return to 100% if the welding quality is not acceptable. When the pipe diameter is less than 16", the line-up clamp may be removed upon completion of tack welds (minimum 50% of total joint) adequate to prevent the loss of joint spacing, the development of high-low, or the formation of cracks in the tack welds or stringer bead. Under no circumstances shall the line-up clamp be removed while welding is in progress or when the metal temperature is above 400°.

O. Cleaning

All rust, dirt, and foreign matter shall be removed from the bevel surface before welding is started. The bevel surface includes all areas in immediate proximity to the pipe end on both the I.D. and O.D. Slag shall be removed from the surface before the next bead is applied. Power tools may be used. The finished weld and immediately adjacent pipe must be cleaned of all flux, smoke debris and weld spatter. All welds will be visually inspected to ensure compliance with the qualified welding procedure.

P. Preheat

Preheat shall be required when the ambient or metal surface temperature is below 40° for all pipe grades. The minimum preheat temperature is 200° to be applied to an area no less than 3" either side of the joint. If moisture is present on the parent metal, it shall be driven off by preheating to temperature at which it will not reform during the welding operation.

27.03.02 Gas Metal Arc Welding and Flux Cored Arc Welding (GMAW / FCAW) Butt Welding General Specification

A. Reference

API 1104, Nineteenth Edition

City of Duluth Procedure DPWU-6, DPWU-14, DPWU-15

B. Process

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Welding shall utilize the Gas Metal Arc Welding and Flux Cored Arc Welding (GMAW & FCAW) processes.

C. Base Metals

Pipe welded according to this standard shall include ASTM A53, API 5L Grade B, and API 5L X42 through X60.

D. Diameter and Wall Thickness

This standard shall apply to pipe having a diameter equal to and larger than 2-1/2 NPS through 16 NPS. The wall thickness shall be equal to and larger than 0.188 inch up to and including 0.750 inch.

E. Joint Design

The joint ends shall be beveled to an angle of 30°, +5°, -0°, with a root face of 1/16", $\pm$ 1/32". Bevels shall form a "V" groove with an included angle of 60°. The root opening shall be 1/16", $\pm$ 1/32".

F. Filler Metal

The filler metal shall conform to AWS A5.18, ER70S-6, Group F-6 (ASME) Weld Analysis A-1 for the first pass (root) and AWS A5.29, E81T1-Ni1M, Group F-6 (ASME) Weld Analysis A-1 for subsequent passes (hot pass, fill and cap).

G. Size of Electrodes and Number of Beads

Wall Thickness (inches)	Stringer Bead ER70S-6	Hot Pass E81T1-Ni1M	Fill and Cap E81T1-Ni1M
0.188-0.750	0.035"	0.045"	0.045"

The minimum number of passes is dependent on wall thickness but shall not be less than 3 passes with no pass deposited thicker than 1/8".

H. Electrical Characteristics

The welding current shall be D.C. current, Reverse Polarity (electrode positive).

Electrode	Rod Diameter	Amperage	Voltage
ER70S-6	0.035"	110 - 150	18 - 24
E81T1-Ni1M	0.045"	190 - 220	20 - 29

I. Direction of Welding

Welding shall be horizontal, rolled (down-hand with the pipe rolled).

J. Speed of Travel

The speed of travel should be within the range of 10 - 15 inches per minute for GMAW and 10 - 19 inches per minute for FCAW.

K. Number of Welders

When the nominal pipe diameter is less than 16", one welder may be used to run the stringer bead (root bead). When the nominal pipe diameter is 16" or greater, two welders will be required to run the stringer bead and hot pass.

L. Time Lapse Between Passes

The second pass (hot pass) shall follow the stringer bead (root bead) within five minutes. Subsequent passes shall be initiated within five minutes of the completion of the previous pass. A minimum of 3 passes shall be completed before the end of the day. Any weld that is not finished the day it is started shall be finished the next workday.

M. Type of Line-up Clamp

Fabrication, Maintenance, and Tie-in welding: External line-up clamps should be used on all sizes of welds.

N. Removal of Line-up Clamp

On 16" or larger pipe, the line-up clamp shall remain in place until 100% of the stringer bead (root bead) is completed. The department may reduce said percentage if, in its sole judgment, acceptable welds can be produced at that reduced percentage. However, the department retains the right to require the contractor to return to 100% if the welding quality is not acceptable. When the pipe diameter is less than 16", the line-up clamp may be removed upon completion of tack welds (minimum of 50% of total joint) adequate to prevent the loss of joint spacing, the development of high-low, or the formation of cracks in the tack welds or stringer bead. Under no circumstances shall the line-up clamp be removed while welding is in progress or when the metal temperature is above 400°.

O. Cleaning

All rust, dirt, and foreign matter shall be removed from the bevel surface before welding

is started. The bevel surface includes all areas in immediate proximity to the pipe end on both the I.D. and O.D. Slag shall be removed from the surface before the next bead is applied. Power tools may be used. The finished weld and immediately adjacent pipe must be cleaned of all flux, smoke debris and weld spatter. All welds will be visually inspected to ensure compliance with the qualified welding procedure.

P. Preheat

Preheat shall be required when the ambient or metal surface temperature is below 40° for all pipe grades. The minimum preheat temperature is 200° to be applied to an area no less than 3" either side of the joint. If moisture is present on the parent metal, it shall be driven off by preheating to a temperature at which it will not reform during the welding operation.

**27.03.03 Shielded Metal Arc Welding (SMAW) Single Bevel Branch Connection
General Specification**

A. Reference

API 1104, Nineteenth Edition

City of Duluth Procedure DPWU-2, DPWU-16, DPWU-17

B. Process

Welding shall utilize the Shielded Metal Arc Welding (SMAW) process.

C. Base Metals

Pipe welded according to this standard shall include ASTM A53, API 5L Grade B, and API 5L X42 through X60. Pipe 2 NPS and smaller shall be limited to ASTM A53, API 5L Grade B or equivalent.

D. Diameter and Wall Thickness

This standard shall apply to pipe having a diameter on the branch equal to or greater than 1/2 inch up to 12.75 inches. The main may be 2-inch NPS through 16-inch NPS. The wall thickness shall be equal to and larger than 0.154 inch up to and including 0.750 inch.

E. Joint Design

Branch ends shall be beveled to an angle of 45°, +5°, -0°, with a root face of 1/16", ± 1/32". The root opening shall be 1/16", ± 1/32".

F. Filler Metal

The filler metal shall conform to AWS A5.1, E6010, Group F-3 (ASME) Weld Analysis A-1 for the first pass (root) and AWS A5.5, E8010-G, Group F-3 (ASME) Weld Analysis A-1 for subsequent passes (hot pass, fill and cap).

G. Size of Electrodes and Number of Beads

Wall Thickness (inches)	Stringer Bead E6010	Hot Pass E8010-G	Fill and Cap E8010-G
< 0.188	3/32"	3/32"	1/8"
0.188 - 0.750	1/8" - 5/32"	1/8" - 3/16"	1/8" - 3/16"

The minimum number of passes is dependent on wall thickness but shall not be less than 3 passes with no pass deposited thicker than 1/8". If welding on pressurized pipelines, the maximum electrode size shall be 1/8".

H. Electrical Characteristics

The welding current shall be D.C. current, Reverse Polarity (electrode positive).

Electrode	Rod Diameter	Amperage	Voltage
E6010	3/32"	60 - 100	20 - 26
E6010	1/8"	75 - 130	20 - 27
E6010	5/32"	90 - 170	20 - 27
E8010-G	3/32"	60 - 100	20 - 26
E8010-G	1/8"	75 - 130	20 - 27
E8010-G	5/32"	90 - 170	24 - 27
E8010-G	3/16"	140 - 190	24 - 27

I. Direction of Welding

Welding shall progress downward from top or any point on the side of the pipe to bottom center.

J. Speed of Travel

The speed of travel should be within the range of 3 - 14 inches per minute.

K. Number of Welders

When the nominal pipe diameter is less than 16", one welder may be used to run the stringer bead (root bead). When the nominal pipe diameter is 16" or greater, two welders will be required to run the stringer bead and hot pass.

L. Time Lapse Between Passes

The second pass (hot pass) shall follow the stringer bead (root bead) within five minutes. Subsequent passes shall be initiated within five minutes of the completion of the previous pass. A minimum of 3 passes shall be completed before the end of the day. Any weld that is not finished the day it is started shall be finished the next workday.

M. Type of Line-up Clamp

Spacing tools and manual holding during tacking off is acceptable if correct stringer bead space and proper alignment is maintained. If this is not possible, then mechanical holding devices shall be required.

N. Removal of Line-up Clamp

On 16" or larger pipe, the line-up clamp shall remain in place until 100% of the stringer bead (root bead) is completed. The department may reduce said percentage if, in its sole judgment, acceptable welds can be produced at that reduced percentage. However, the department retains the right to require the contractor to return to 100% if the welding quality is not acceptable. When the pipe diameter is less than 16", the line-up clamp may be removed upon completion of tack welds (minimum of 50% of total joint) adequate to prevent the loss of joint spacing, the development of high-low, or the formation of cracks in the tack welds or stringer bead. Under no circumstances shall the line-up clamp be removed while welding is in progress or when the metal temperature is above 400°.

O. Cleaning

All rust, dirt, and foreign matter shall be removed from the bevel surface before welding is started. The bevel surface includes all areas in immediate proximity to the pipe end on both the I.D. and O.D. Slag shall be removed from the surface before the next bead is applied. Power tools may be used. The finished weld and immediately adjacent pipe must be cleaned of all flux, smoke debris and weld spatter. All welds will be visually inspected to ensure compliance with the qualified welding procedure.

P. Preheat

Preheat shall be required when the ambient or metal surface temperature is below 40° for all pipe grades. The minimum preheat temperature is 200° to be applied to an area no less than 3" either side of the joint. If moisture is present on the parent metal, it shall be driven off by preheating to a temperature at which it will not reform during the welding operation.

27.03.04 Shielded Metal Arc Welding (SMAW) Fillet Weld General Specification

A. Reference

API 1104, Nineteenth Edition

City of Duluth Procedure DPWU-3, DPWU-11

B. Process

Welding shall utilize the Shielded Metal Arc Welding (SMAW) process.

C. Base Metals

Pipe welded according to this standard shall include ASTM A53, API 5L Grade B, and API 5L X42 through X60. Pipe 2 NPS and smaller shall be limited to ASTM A53, API 5L Grade B or equivalent.

D. Diameter and Wall Thickness

This standard shall apply to pipe having a diameter equal to and larger than 2 NPS through 16 NPS. The wall thickness shall be equal to and larger than 0.154 inch up to and including 0.750 inch.

E. Joint Design

The joint shall nominally be a 90° angle between the adjacent faces of the base metals. The maximum root opening shall not exceed 1\16". The face of the fillet weld shall be flat to slightly convex. The toes of the fillet weld shall fair smoothly into the adjacent base metal.

F. Filler Metal

The filler metal shall conform to AWS A5.1, E6010, Group F-3 (ASME) Weld Analysis A-1 for the first pass (root) and AWS A5.5, E8010-G, Group F-3 (ASME) Weld Analysis A-1 for subsequent passes (hot pass, fill and cap).

G. Size of Electrodes and Number of Beads

Wall Thickness (inches)	Stringer Bead E6010	Hot Pass E8010-G	Fill and Cap E8010-G
< 0.188	3/32"	3/32"	1/8"
0.188 - 0.750	1/8" - 5/32"	1/8" - 3/16"	1/8" - 3/16"

The minimum number of passes is dependent on fillet weld size but shall not be less than 3 passes with no pass deposited thicker than 1/8".

H. Electrical Characteristics

The welding current shall be D.C. current, Reverse Polarity (electrode positive).

Electrode	Rod Diameter	Amperage	Voltage
E6010	3/32"	60 - 100	20 - 26
E6010	1/8"	75 - 130	20 - 27
E6010	5/32"	90 - 170	20 - 27
E8010-G	3/32"	60 - 100	20 - 26
E8010-G	1/8"	75 - 130	20 - 27
E8010-G	5/32"	90 - 170	24 - 27
E8010-G	3/16"	140 - 190	24 - 27

I. Direction of Welding

Welding shall progress downward from top or any point on the side of the pipe to bottom center.

J. Speed of Travel

The speed of travel should be within the range of 3 - 14 inches per minute.

K. Number of Welders

When the nominal pipe diameter is less than 16", one welder may be used to run the stringer bead (root bead). When the nominal pipe diameter is 16" or greater, two welders will be required to run the stringer bead and hot pass.

L. Time Lapse Between Passes

The second pass (hot pass) shall follow the stringer bead (root bead) within five minutes. Subsequent passes shall be initiated within five minutes of the completion of the previous pass. A minimum of 3 passes shall be completed before the end of the day. Any weld that is not finished the day it is started shall be finished the next workday.

M. Type of Line-up Clamp

Fabrication, Maintenance, and Tie-in Welding: External line-up clamps should be used on all sizes of welds.

N. Removal of Line-up Clamp

On 16" or larger pipe, the line-up clamp shall remain in place until 100% of the stringer bead (root bead) is completed. The department may reduce said percentage if, in its sole judgment, acceptable welds can be produced at that reduced percentage. However, the department retains the right to require the contractor to return to 100% if the welding quality is not acceptable. When the pipe diameter is less than 16", the line-up clamp may be removed upon completion of tack welds (minimum of 50% of total joint) adequate to prevent the loss of joint spacing or the formation of cracks in the tack welds or stringer bead. Under no circumstances shall the line-up clamp be removed while welding is in progress or when the metal temperature is above 400°.

O. Cleaning

All rust, dirt, and foreign matter shall be removed from the fillet weld surface before welding is started. The fillet weld surface includes all areas in immediate proximity to the fillet weld joint. Slag shall be removed from the surface before the next bead is applied. Power tools may be used. The finished weld and immediately adjacent pipe must be cleaned of all flux, smoke debris and weld spatter. All welds will be visually inspected to ensure compliance with the qualified welding procedure.

P. Preheat

Preheat shall be required when the ambient or metal surface temperature is below 40° for all pipe grades. The minimum preheat temperature is 200° to be applied to an area no less than 3" either side of the joint. If moisture is present on the parent metal, it shall be driven off by preheating to a temperature at which it will not reform during the welding operation.

27.04 Maintaining Welding Qualification

A welder can maintain qualification for butt welds if during the previous 6 months at

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least one weld has been tested and found acceptable under API Standard 1104, Nineteenth Edition, Section 6 or Section 9.

A welder can maintain qualification for fillet welds if during the previous 6 months at least one weld has been tested and found acceptable under API Standard 1104, Nineteenth Edition, Section 6 or Section 9.

27.05 Records

The Engineering Division will keep qualification documents for Department Welders and a copy of requalification records.

Qualification documents submitted for contract welders will be filed in job file for that particular contract and kept for the life of the pipeline.

27.06 Nondestructive Testing

27.06.01 City of Duluth Inspection and Testing of Welds Requirements

- A. Visual inspection of welding must be conducted by an individual qualified by appropriate training and experience to ensure that:
1. The welding is performed in accordance with the welding procedure; and
 2. The weld is acceptable under Paragraph (C) of this section.
- B. The welds on a pipeline to be operated at a pressure that produces a hoop stress of 20% or more of SMYS must be nondestructively tested in accordance with sections 27.06.02, 27.06.03, and 27.06.04, except that welds that are visually inspected and approved by a qualified welding inspector need not be nondestructively tested if:
1. The pipe has a nominal diameter of less than 6 inches; or
 2. The pipeline is to be operated at a pressure that produces a hoop stress of less than 40% SMYS and the welds are so limited in number that nondestructive testing is impractical.
- C. The acceptability of a weld that is nondestructively tested or visually inspected is determined according to the standards in Section 9 of API 1104 Nineteenth Edition. However, if a girth weld is unacceptable under those standards for a reason other than a crack, and if Appendix A to API 1104 applies to the weld, the acceptability of the weld may be further determined under that appendix.

27.06.02 City of Duluth Selection of Welds for Nondestructive Testing

- A. When nondestructive testing is required under 27.06.01(B), the following percentages of each day's field butt welds, selected at random by the City of Duluth, must be nondestructively tested over their entire circumference.
1. In Class 1 locations, at least 10%
 2. In Class 2 locations, at least 15%
 3. In Class 3 and Class 4 locations, at crossings of major or navigable rivers, offshore, and within railroad or public highway rights-of-way, including tunnels, bridges, and overhead road crossings, 100% unless impracticable, in which case at least 90%. Nondestructive testing must be impracticable for each girth weld not tested.
 4. At pipeline tie-ins, including tie-ins of replacement sections, 100%
- B. Except for a welder whose work is isolated from the principal welding activity, a sample of each welder's work for each day must be nondestructively tested when nondestructive testing is required under 27.06.01(B).
- C. When nondestructive testing is required under 27.06.01(B), the City of Duluth must retain, for the life of the pipeline, a record showing by milepost, engineering station, or by geographic feature, the number of girth welds made, the number nondestructively tested, the number rejected, and the disposition of the rejects.

27.06.03 Vendor NDT Method Requirements

Nondestructive testing of welds must be performed by any process, other than trepanning, that will clearly indicate defects that may affect the integrity of the weld. These methods include Magnetic Particle, Liquid Penetrant, Radiographic and Ultrasonic methods.

27.06.04 Vendor Documentation Requirements

- A. The vendor shall submit written procedures for each NDT method that is proposed for use in the inspection of pipeline girth welds or other welds.
- B. The written procedures shall include methods for establishing the proper interpretation of each nondestructive test of a weld to ensure the acceptability of the weld under section 27.06.01(C).
- C. The vendor shall submit the NDT Certification/Qualification records of the individuals who will perform and/or interpret the nondestructive tests.

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Figure 27-1 Coupon Test Report

COUPON TEST REPORT							
Date _____				Test No. _____			
Location _____							
State _____				Weld Position: _____		Roll ☐ Fixed ☐	
Welder _____				Mark _____			
Welding time _____				Time of day _____			
Mean temperature _____				Wind break used _____			
Weather conditions _____							
Voltage _____				Amperage _____			
Welding machine type _____				Welding machine size _____			
Filler metal _____							
Reinforcement size _____							
Pipe type and grade _____							
Wall thickness _____				Outside diameter _____			
	1	2	3	4	5	6	7
Coupon stenciled							
Original specimen dimensions							
Original specimen area							
Maximum load							
Tensile strength							
Fracture location							
☐ Procedure ☐ Qualifying test ☐ Qualified ☐ Welder ☐ Line test ☐ Disqualified							
Maximum tensile _____		Minimum tensile _____		Average tensile _____			
Remarks on tensile-strength tests _____							
1. _____							
2. _____							
3. _____							
4. _____							
Remarks on bend tests _____							
1. _____							
2. _____							
3. _____							
4. _____							
Remarks on nick-break tests _____							
1. _____							
2. _____							
3. _____							
4. _____							
Test made at _____				Date _____			
Tested by _____				Supervised by _____			
Note: Use back for additional remarks. This form can be used to report either a procedure qualification test or a welder qualification test.							

Welding Procedure Matrix

Procedure Number	Process	Wall Thickness
DPWU-1	SMAW	$0.188'' \leq t \leq 0.750''$
DPWU-2	SMAW	$t < 0.188''$
DPWU-3	SMAW	$0.188'' \leq t \leq 0.750''$
DPWU-4	SMAW	$0.188'' \leq t \leq 0.750''$
DPWU-6	GMAW/FCAW	$t < 0.188''$
DPWU-7	GMAW/FCAW	$t < 0.188''$
DPWU-10	SMAW	$0.188'' \leq t \leq 0.750''$
DPWU-11	SMAW	$0.188'' \leq t \leq 0.750''$
DPWU-14	GMAW/FCAW	$t < 0.188''$
DPWU-15	GMAW/FCAW	$0.188'' \leq t \leq 0.750''$
DPWU-16	SMAW	$t < 0.188''$
DPWU-17	SMAW	$0.188'' \leq t \leq 0.750''$
DPWU-18	SMAW	$t < 0.188''$
DPWU-19	SMAW	$0.188'' \leq t \leq 0.750''$

GAS OPERATION & MAINTENANCE MANUAL
SECTION 28: QUALIFICATIONS FOR JOINING PE GAS PIPE (192.285)

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28.01 Qualification Tests

- A. Qualification tests are used to determine the ability of those tested to produce sound joints with the equipment, materials, and procedures that are used in the field. It should be realized that the test is conducted under controlled conditions.

Successful passage of the test does not guarantee that a person will make sound joints under all field conditions.

- B. The qualification test shall be successfully completed by each joiner employed by the Department or by an employee of a contractor before being permitted to make joints on the Department's gas plastic P.E. system.

- C. Joiners may be qualified in one or more of the following categories:

<u>Fusion</u>	Socket Saddle Butt Electrofusion
<u>Mechanical</u> (Dept. only)	Lyco-Fit Chicago Fitting Continental Con-stab

28.02 Identification Cards

Qualified contractor fusors must carry on their person a Department-issued certification card which will be issued by the Department upon passage of the qualification test. This card must be presented on request. The card will indicate if fusor is qualified for socket, saddle, butt fusion or electrofusion. The inspector shall verify by office records that the fusor's qualifications are current. In addition each fusor will have available the standard specification for fusion.

28.03 Qualification Records

The Chief Engineer or his/her designee shall maintain a record of each test and shall maintain a list of currently qualified persons in each category. Persons who do not requalify during the required interval shall be deleted from the current list. The list shall contain both Department and Contractor joiners.

Old lists and test records shall be kept for seven years.

28.04 Qualification of Inspectors (192.287)

Each person responsible for inspecting fusion joining must be qualified by training or experience in evaluating whether joints made according to the procedure in this manual are acceptable.

Each inspector will be qualified, in addition to experience or other training, by passage of Part I of the qualification test which is the written portion. Part II is the Joint Fabrication portion of the test. Persons who qualify on both Part I and Part II are also considered qualified to inspect provided that their certificate has not expired.

28.05 Fusion Qualification Procedure

28.05.01 General

Qualification testing is conducted in two parts. Part I must be passed before proceeding to Part II.

28.05.02 Part I – Written Test

This test may or may not be preceded by classroom training. The test shall consist of questions pertinent and critical to making satisfactory joints. Questions may be derived from information provided in Section 16.07 of the Standard Specifications titled "Joining Pipe and Fittings". Reference material will not be permitted to be used during test and measures will be taken by the test monitor to assure same.

An overall score of 75% is required to pass the written test.

28.05.03 Part II – Joint Fabrication Test

Fabrication of various fusion joints will be done by the applicant, in the presence of a Department-qualified fuser at the Department Utility Operations Division, 520 Garfield Avenue.

Plastic pipe and fittings for socket, saddle and butt will be furnished by Department.

Tools and irons for socket, saddle and butt fusion joining must be provided by the applicant.

Tools, equipment, piping, and fittings for electrofusion must be provided by the applicant.

A fee shall be charged to recover costs of the testing.

Applicant may not refer to manual or written notes during Joint Fabrication Test.

Completed Assembly must be as it appears in the detail shown in Figure 28-1.

28.06 Heat Fusion Qualification Requirements

A. The fabricated assembly completed by the applicant shall be subjected to visual inspection for comparison with standard pipe manufacturer photos for acceptable and not acceptable joints.

B. The following defects will result in a failed test:

1. Failure to follow procedures
2. Visual defect
3. Failure during destructive test

C. Tests

1. Socket (2" and 1/2") Visual and Destructive

The applicant must complete a socket type joint for testing by the Department. The test will include cutting three strips, 1" wide and 6" along the pipe through the joint. The test will include bending the strips 180° over and checking for disbondment.

2. Service Punch Tee (2" x 1/2") Visual and Destructive

The applicant must complete a service punch tee type joint, including tapping the service tee prior to testing by the Department. The test will include slipping a 1-1/2" steel pipe over the top of the service punch tee (cap must be removed) and bending the tee to 45° in all directions to attempt to disbond service tee from main.

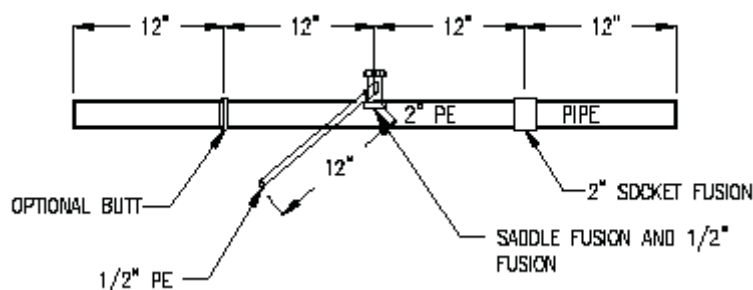
The punch tee will also be sawed in half at 90° to the main line to check for overmelt at the 1/2" pipe connection to the service punch tee which may cause orificing at the connection.

3. Butt (2") Visual and Destructive

The applicant must complete a butt type joint for testing by the Department. The test will include cutting three strips, 1" wide and 6" along the pipe through the joint. The test will include bending the strips 180° over and checking for disbondment.

The butt joint test, if done alone, may be done on 2", 3", 4", 6" or 8" pipe.

Figure 28-1
Fabricated Assembly for P.E. Fusion Qualification Test Part III



28.07 Electrofusion Qualification Requirements (192.285)

Applicants qualifying for electrofusion shall be certified according to Section 28.05. In addition, the applicant shall make an electrofuse coupling joint and/or a sidewall/saddle including tapping a fusion service tee. The applicant must be tested for each type of work that they will be performing for the utility.

The test will include a visual inspection and cutting three test strips, 1" wide and 6" along the pipe through the joint. The test will include bending the strips 180° over and checking for disbondment.

Prior to any testing by the Department, the applicant must tap the fusion service tee in the proper manner in order to be qualified to fuse and tap service tees.

28.08 Mechanical Qualification Requirements (Department Only)

Applicants qualifying to connect plastic pipe using mechanical type fittings shall assemble one connection of each type being qualified for in the presence of a tester. Assembly must follow the procedure for the fitting as shown in Section 16.07 "Joining Pipe & Fittings."

Tester shall monitor the assembly for procedural correctness and examine the finished assembly for comparison to a proper assembled fitting. Destructive or pressure testing is not required.

28.09 Requalification Requirements

Requalification shall be accomplished by making at least one joint on the job site each year for each joint type. If no jobs are in progress, then at least one joint shall be made in the shop and tested before the due date of the fuser's annual requalification.

A person must be requalified annually or any time they have any joints found unacceptable by pressure testing or visual inspection for that type of joint.

All fusing certificates expire March 31st of each year unless the fuser was certified after January 1st of that year.

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SECTION 29: SERVICE LINES (192.351)

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29.01 New Service Lines- Location (192.353)

New services should be installed at right angles from the main to the riser location where terrain or obstructions are not a problem. Riser location is determined by meter location criteria and will generally be located on the front, facing the main or on the side within six feet of the front which faces the main.

29.02 Excess Flow Valve (EFV) (192.383)

An excess flow valve will be installed on all services where the meter(s) is rated for 1,000 ccf or less. The only exception is where contaminants could be expected to cause the excess flow valve to malfunction.

The Public Works and Utilities Department will furnish excess flow valves for installation by the Contractor on all new or replaced gas services of the applicable size.

The presence of an excess flow valve shall be identified on the service card records and the service riser tagged with a sticker or similar identifier provided from the excess flow valve manufacturer.

The excess flow valve shall be located as near as practical to the fitting connecting the service line to its source of gas supply as shown on the standard details.

29.03 Inactive Service (Shut off but not disconnected) (192.379)

Whenever a service is inactive (shut off, but not disconnected), the meter stop valve at the meter(s) shall be shut off and locked to prevent the opening of the valve by unauthorized personnel. When a curb valve is present, it should also be shut off. Open ends of piping shall be capped or plugged on both the service side and fuel line side.

29.04 Abandoning Service (192.727)

Service to be abandoned shall be physically cut off from the main according to Section 21. If the service line is larger than 1/2" it shall be purged of gas before being abandoned. If service valve is closed and blind-flanged or capped downstream, the record should remain as active service with cutoff and cap so noted. The Engineering Division shall maintain record of abandonment in the Abandoned Service Card File and in EAM.

29.05 Reactivation of Service (192.725)

Any service line to be reactivated which was temporarily disconnected from the mains, including repair of 3rd party hits, must be tested from the point of disconnection to the meter stop valve in the same way as a new service line. The service must be tested at

a minimum of 100 PSIG for one half (1/2) hour. All plastic services are to be tested at 100 PSIG. Final connection fittings that were not air tested will be soap tested.

Records of the test must be kept for the life of the service. The records must include the following:

- A. The employee's name and date of test
- B. Test pressure
- C. Test duration
- D. Leak and failures noted and corrective action taken

Any time the reconnection occurs next to the main, an excess flow valve must be installed if the service meter(s) is 1,000 ccf or less.

29.06 Reconnection of Active Service to New Main

Any service line that is disconnected from an existing main and immediately reconnected to a new main shall not require testing. The new portion of the service including the service tee, valve (if required) and EFV (if required) shall be tested per the same requirements as a new service per Section 19.

29.07 Temporary Overland Service Lines

29.07.01 Limits on Use of Temporary Overland Service Lines

Temporary service lines may be installed all or partially overland (above ground) if necessary to maintain gas supply while a service is being maintained or modified or to supply gas to a new customer whose existing furnace has failed during the winter season. This does not apply to new construction or non-emergency conversions. All materials shall meet the requirements of Section 14.

29.07.02 Short Term (less than 48 hours)

For bypass or temporary purposes, temporary gas line may be polyethylene, steel, PTFE Hose or other approved material.

29.07.03 Extended Term (greater than 48 hours but less than 4 months)

Low pressure service (maximum 2 PSI) running above grade shall be limited to steel, copper, PTFE Hose or double reinforced neoprene fuel air hose. Pipe or hose used shall be tested at 50 psi for 10 minutes and a label attached showing test pressure, duration, date, and name of tester. Field connectors shall be soap tested or tested with gas scope.

High pressure services (greater than 2 PSI) running above grade shall be polyethylene

or steel. Pipe shall be tested in accordance with Section 19, Gas Main Testing. All connectors must be soap-tested or leak-tested with gas scope.

Where polyethylene pipe is used, it shall be new pipe that has previously been stored indoors and not subjected to UV light.

29.07.04 Source

Temporary service may extend from: high pressure gas main fronting on property; or the low or high pressure side of an adjoining customer meter set, with permission of customer.

29.07.05 Special Protection

Temporary service line must be protected when laid over driveways with a steel casing fixed to the surface and ramped with asphalt or other means.

Only Department personnel shall install overland temporary services. Owners' plumber must install temporary or permanent meter connection.



City of Duluth, Minnesota

Public Works & Utilities Department - Engineering Division

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APPENDIX B

Schedule for Materials Testing

**SCHEDULE FOR MATERIALS TESTING
CITY OF DULUTH STREET AND UTILITY PROJECTS**

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The Engineer will perform materials testing for acceptance and quality assurance at these minimum rates. When deemed appropriate, the Engineer will perform additional testing to determine acceptance. Additional testing and retesting shall be at the Contractor's expense.

Specified Method	Sampling & Testing	Sampling Notes	Compaction Testing	Compaction Notes
UTILITY COMPACTION				
Specified Density	One sieve and proctor for each backfill borrow material at source and one for each different classification of onsite native material.	<u>Materials to be tested:</u> - Course filter aggregate - Granular backfill - Native material from site <u>Note:</u> If material looks like it changed, test again.	- Take moisture of native material on first day of utility work. - Take densities at rate of; One per each 200' of mainline pipe, One per each 4 service laterals, and One per each 4 manholes at every 3 feet in depth. - Required compaction is 100% around manholes full depth; 100% in the top 3 feet of utility trench below top of subgrade; 95% in utility trench below the top 3 feet.	- Compact backfill in 8" lifts. - Additional tests where inspector notes rutting or pumping; additional moistures after wet weather. - Most common problem is too much moisture in native backfill; may require granular borrow backfill to be used. - Retest at contractor's cost.
SELECT GRANULAR BORROW				
Specified Density	One sieve and proctor from source.	Take additional samples if material changes or source changes, at contractor's cost	- Take densities at rate of: Four per Block prior to Class 5. - Compact in 8" layers or less. - Required density is 100%.	- Take additional densities where rutting is noted. - The most common problem with select granular is not enough moisture or more than 7%. - Retest at contractor's cost.
CLASS 5				
Specified Density	One sieve and proctor at source.	Take additional samples if material changes or source changes, at contractor's cost.	- Take densities at rate of: Two per Block prior to curb and gutter and/or paving. - Required density is 100%.	- Excavate and re-compact areas where visible rutting. - Most common problem is segregation of aggregates; replacement/blending as directed by the Engineer. - Retest at contractor's cost.

**SCHEDULE FOR MATERIALS TESTING
CITY OF DULUTH STREET AND UTILITY PROJECTS
Page 2 of 2**

CONCRETE CURB & GUTTER, SIDEWALK AND APRONS			
Field Testing	Cylinders	Plant Inspection	Concrete Aggregate Graduations
• Test two trucks early in the day (first 2 trucks if possible) for air and slump. • Test air & slump 2 times per Block, one on each side. • Note: If less than 200 ft., no test required.	• Two sets per Block, one on each side.	• One inspection per project on either curb & gutter or sidewalk.	• One test/aggregate pile for the mix placed during the plant inspection.
• Test two trucks early in the day (first two trucks if possible) for air and slump. • Two tests per Block, one on each side.	• Two tests per Block, one on each side.	• One inspection per project on either curb & gutter or sidewalk.	• One test/aggregate pile for the mix placed during the plant inspection.

BITUMINOUS	
Quality Assurance Testing (Owner's Testing Agency)	Quality Control Testing (Suppliers Testing)
• For S.I.P. projects, one companion sample (split with contractor) per mix placed per project. Test for asphalt content, gradation, and air voids. • No plant inspection required by owners testing agency on S.I.P projects. • One companion core for density from contractor per lot per lift. One lot for 300–600 tons, two lots for 601-1000 tons, three lots for 1001–1600 tons, four lots for 1601 – 3600 tons.	• Percent crushing - two per/mix/day at start-up, then sample daily, test minimum of one weekly. • Plant aggregate gradation – one/1000 tons at start-up, then one/2000 tons. • Asphalt content and air voids– one/500 tons/mix for first 2000 tons, then one/1000 tons. • Core density – three cores per lot per lift (see QA for lot determination). Two tested by supplier and one forwarded to owner's testing agency.

*Cores for Bituminous Quality Assurance Testing shall be provided by the Contractor.



City of Duluth, Minnesota

Public Works & Utilities Department - Engineering Division

Standard Construction Specifications - 2019 Edition

APPENDIX C

Project Labor Agreement

CITY OF DULUTH PROJECT LABOR AGREEMENT

ARTICLE I PURPOSE

This Agreement is entered into as of the date of attestation by the City Clerk, by and between Click or tap here to enter text., its successors or assigns (hereinafter “Project Contractor”), and the City of Duluth, (hereinafter “Owner”) and the Duluth Building and Construction Trade Council, on behalf of its affiliated local unions, acting on their own behalf and on behalf of their respective affiliates and members whose names are subscribed hereto and who have, through their duly authorized officers, executed this Agreement (hereinafter collectively called the “Union or Unions”), with respect to the construction of the Click or tap here to enter text. (hereinafter “Project”).

The term “Contractor” shall include all construction contractors and subcontractors of whatever tier engaged in construction work within the scope of this Agreement, including the Project Contractor when it performs construction work within the scope of this Agreement. Where specific reference to Click or tap here to enter text. alone is intended, the term “Project Contractor” is used.

The parties recognize the need for the timely completion of the Project without interruption or delay. This Agreement is intended to establish a framework for labor-management cooperation and stability. The Contractor(s) and the Unions agree that the timely construction of this Project will require substantial numbers of employees from construction and supporting crafts possessing skills and qualifications that are vital to its completion. They will work together to furnish skilled, efficient craft workers for the construction of the Project.

Further, the parties desire to mutually establish and stabilize wages, hours and working conditions for the craft workers on this construction project, to encourage close cooperation between the Contractor(s) and the Unions to the end that a satisfactory, continuous and harmonious relationship will exist between the parties to this Agreement.

Therefore, in recognition of the special needs of this Project and to maintain a spirit of harmony, labor-management peace, and stability during the term of this Agreement, the parties agree to abide by the terms and conditions in this Agreement, and to establish effective and binding methods for the settlement of all misunderstandings, disputes or grievances which may arise. Further, the Contractor(s) and all contractors of whatever tier, agree not to engage in any lockout, and the Unions agree not to engage in any strike, slow-down, or interruption or other disruption of or interference with the work covered by this Agreement.

¹ Where the work is performed under Contract with the City of Duluth, the “Owner” is the City of Duluth. Where the Owner receives financial assistance or payment from the City the Owner is the corporation, firm or other entity that is receiving the assistance or payment.

ARTICLE II

SCOPE OF AGREEMENT

Section 1. This Project Labor Agreement shall apply and is limited to all construction work included in all bid categories for the Project under the direction of and performed by the Contractor(s), of whatever tier, which may include the Project Contractor, who have contracts awarded for such work on the Project. Such work shall include site preparation work and dedicated off-site work.

The Project is defined as: [Click or tap here to enter text.](#)

Section 2. It is agreed that the Project Contractor shall require all Contractors of whatever tier who have been awarded contracts for work covered by this Agreement to accept and be bound by the terms and conditions of this Project Labor Agreement by executing the “Agreement to be Bound” form attached as Exhibit 1 prior to commencing work. This Project Labor Agreement is a material term of the bid specifications for the Project and therefore, regardless of whether a contractor executes this Agreement, by virtue of the owner and/or Project Contractor accepting the bid offer of the Contractor, a Contractor who performs work on this project is bound to this PLA regardless of their execution of this Agreement. The Project Contractor shall assure compliance with this Agreement by the Contractors. It is further agreed that, where there is a conflict, the terms and conditions of this Project shall supersede and override terms and conditions of any and all other national, area, or local collective bargaining agreements, except for all work performed under the NTL Articles of Agreement, The National Stack/Chimney Agreement, the National Cooling Tower Agreement, all instrument calibration work and loop checking shall be performed under the terms of the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors, with the exception of Article V, VI and VII of this Project Labor Agreement, which shall apply to such work. It is understood that this is a self-contained, stand alone, Agreement and that by virtue of having become bound to this Project Agreement, neither the Project Contractor nor the Contractors will be obligated to sign any other local, area or national agreement.

Section 3. Nothing contained herein shall be construed to prohibit, restrict or interfere with the performance of any other operation, work, or function which may occur at the Project site or be associated with the development of the Project.

Section 4. This Agreement shall only be binding on the signatory parties hereto and shall not apply to their parents, affiliates or subsidiaries.

Section 5. The Owner and/or Project Contractor have the absolute right to select any qualified bidder for the award of contracts on this Project without reference to the existence or non-existence of any agreements between such bidder and any party to this Agreement; provided, however, only that such bidder is willing, ready and able to become a party to and comply with this Project Agreement, should it be designated the successful bidder.

Section 6. As areas and systems of the Project are inspected and construction tested by the Project Contractor or Contractors and accepted by the Owner, the Project Labor Agreement will not have

further force or effect on such items or areas, except when the Project Contractor or Contractors are directed by the Owner to engage in repairs, modifications, check-out, and warranty functions required by its contract with the Owner during the term of this Agreement.

Section 7. It is understood that the Owner, at its sole option, may terminate, delay and/or suspend any or all portions of the Project at any time.

Section 8. It is understood that the liability of any employer and the liability of the separate unions under this Agreement shall be several and not joint. The unions agree that this Agreement does not have the effect of creating any joint employer status between or among the Owner, Contractor(s) or any employer.

Section 9. The provisions of this Project Labor Agreement shall apply to all craft employees represented by any Union listed in Schedule A hereto attached and shall not apply to other field personnel or managerial or supervisor employees as defined by the National Labor Relations Act. No Contractor party is required to sign any other agreement as a condition of performing work within the scope of this Agreement. However, any Contractor performing work on the Project which is not party to a Local Area Labor Agreement for a craft employed by the Contractor, agrees to install hourly wage rates, hours, fringe benefit contributions, referral procedures and all other terms and conditions of employment as fully set forth in the applicable Local Area Agreement as described in Schedule A for work on the Project for each craft employed by the Contractor. But in no event shall the wages be less than the wages that are applicable to this project under the Minnesota Prevailing Wage Act, Minn. Stat. § 177.43. All employees covered by this Agreement shall be classified in accordance with the work performed.

Section 10. The Contractors agree to timely pay contributions to the established employee benefit funds in the amounts designated in the Local Area Labor Agreements attached as Schedule A.

The Contractors adopt and agree to be bound by the written terms of the legally-established Trust Agreements specifying the detailed basis on which payments are to be made into, and benefits paid out of, such Trust Funds. The Contractors authorize the parties to such Trust Agreements to appoint trustees and successor trustees to administer the Trust funds and hereby ratify and accept the Trustees so appointed as if made by the Contractors.

Section 11. All workers delivering fill, sand, gravel, crushed rock, transit/concrete mix, ready mix, asphalt or other similar material and all workers removing any materials from the construction site shall receive a total package of wages and benefits at least and not lower than the wages and benefits provided for in the then current Highway, Heavy Construction Agreement between Teamsters Local 346 and the Associated General Contractors of America, or the Highway Heavy Prevailing Wage Schedule, whichever is greater.

ARTICLE III

UNION RECOGNITION AND UNION SECURITY

Section 1. The Contractors recognize the signatory Unions as the sole and exclusive bargaining representatives of all craft employees within their respective jurisdictions working on the Project within the scope of this Agreement.

Section 2. All employees covered by this Agreement now in the employ of the Contractor shall remain members in good standing in their respective Unions during the term of the Agreement and all employees hereinafter employed by the Contractor will become members of the respective Unions within seven (7) days after the date of their employment and shall remain members of the Unions in good standing during the term of this Agreement.

Section 3. Authorized representatives of the Union shall have access to the Project, provided they do not interfere with the work of employees and further provided that such representatives comply fully with the posted visitor and security and safety rules of the Project.

ARTICLE IV

REFERRAL OF EMPLOYEES

Applicants for the various classifications covered by this Agreement required by the Employer or Contractors on the Project shall be referred to the Contractors by the Unions. The Unions represent that its local unions administer and control their referrals and it is agreed that these referrals will be made in a non-discriminatory manner and in full compliance with Federal and State laws.

ARTICLE V

MANAGEMENT'S RIGHTS

The Project Contractor and Contractors of whatever tier retain full and exclusive authority for the management of their operations. Except as otherwise limited by the terms of this Agreement or the applicable local area agreements, the Contractors shall direct their working forces at their prerogative, including, but not limited to hiring, promotion, transfer, lay-off or discharge for just cause.

ARTICLE VI

WORK STOPPAGES AND LOCKOUTS

Section 1. During the term of this Agreement there shall be no strikes, picketing, work stoppages, slowdowns or other disruptive activity for any reason by the Unions or by any employee, and there shall be no lockout by the Contractor. Failure of any Union or employee to cross any picket line established at the Project site is a violation of this Article.

Section 2. The Unions shall not sanction, aid or abet, encourage or continue any work stoppage, strike, picketing or other disruptive activity at the Contractor's project site or any site of a contractor or supplier necessary for the performance of work at the project site and shall undertake all reasonable means to prevent or to terminate any such activity. No employee shall engage in

activities which violate this Article. Any employee who participates in or encourages any activities which interfere with the normal operation of the Project shall be subject to disciplinary action, including discharge, and if justifiably discharged for the above reasons, shall not be eligible for rehire on the Project for a period of not less than thirty (30) days.

Section 3. The Unions shall not be liable for acts of employees for whom it has no responsibility. The International Union General President or Presidents will immediately instruct, order and use the best efforts of his office to cause the Local Union or Unions to cease any violations of this Article. An International Union complying with this obligation shall not be liable for unauthorized acts of its Local Union. The principal officer or officers of a Local Union will immediately instruct, order and use the best efforts of his office to cause the employees the Local Union represents to cease any violations of this Article. A Local Union complying with this obligation shall not be liable for unauthorized acts of employees it represents. The failure of the Contractor to exercise its right in any instance shall not be deemed a waiver of its right in any other instance.

Section 4. Any party alleging a breach of this Article shall have the right to petition a court for temporary and permanent injunctive relief. The parties agree that the moving party, upon proving a breach of this Agreement, shall be entitled to temporary and permanent injunctive relief.

ARTICLE VII **SAFETY**

The parties are mutually committed to promoting a safe working environment for all personnel at the job site. It shall be the responsibility of each employer to which this PLA applies to provide and maintain safe working conditions for its employees, and to comply with all applicable federal, state and local health and safety laws and regulations.

ARTICLE VIII **UNION-MANAGEMENT COOPERATION COMMITTEE**

The parties to this Agreement agree to form a Union-Management Committee, consisting of signatory unions, contractors, and representatives of the City of Duluth. The purpose of the Committee is to ensure cooperation on matters of mutual concern, including productivity, quality of work, safety and health.

ARTICLE IX **DISPUTES AND GRIEVANCES**

Section 1. This Agreement is intended to provide close cooperation between management and labor. Each of the Unions will assign a representative to this Project for the purpose of completing the construction of the Project economically, efficiently, continuously, and without interruptions, delays, or work stoppages.

Section 2. The Contractors, Unions, and the employees, collectively and individually realize the importance to all parties to maintain continuous and uninterrupted performance of the work on the

Project, and agree to resolve disputes in accordance with the grievance-arbitration provisions set forth in this Article.

Section 3. Any question or dispute arising out of and during the term of this Project Labor Agreement (other than trade jurisdictional disputes) shall be considered a grievance and subject to resolution under the following procedures:

Step 1. (a) When an employee subject to the provisions of this Agreement feels he or she is aggrieved by a violation of this Agreement, he or she, through his or her local union business representative or job steward, shall, within ten (10) working days after the occurrence of the violation, or knowledge of the violation, give notice to the work-site representative of the involved Contractor stating the provision(s) of the Local Area Agreement and/or this PLA alleged to have been violated. The business representative of the local union or the job steward and the work-site representative of the involved Contractor and the Project Contractor shall meet and endeavor to adjust the matter within three (3) working days after timely notice has been given. The representative of the Contractor shall keep the meeting minutes and shall respond to the Union representative in writing (copying the Project Contractor) at the conclusion of the meeting but not later than twenty-four (24) hours thereafter. If they fail to resolve the matter within the prescribed period, the grieving party may, within forty-eight (48) hours thereafter, pursue Step 2 of the Grievance Procedure, provided the grievance is reduced to writing, setting forth the relevant information concerning the alleged grievance, including a short description thereof, the date on which the grievance occurred, and the provision(s) of the Local Area Agreement and/or this PLA alleged to have been violated.

(b) Should the Local Union(s) or the Project Contractor or any Contractor have a dispute with the other party and, if after conferring, a settlement is not reached within seven (7) working days, the dispute may be reduced to writing and proceed to Step 2 in the same manner as outlined herein for the adjustment of an employee complaint.

Step 2. The Business Manager or his or her designee of a Local Union and the involved Contractor shall meet within seven (7) working days of the referral of a dispute to this second step to arrive at a satisfactory settlement thereof. Meeting minutes shall be kept by the Contractor. If the parties fail to reach an agreement, the dispute may be appealed in writing in accordance with the provisions of Step 3 within seven (7) calendar days thereafter.

Step 3. (a) If the grievance has been submitted but not adjusted under Step 2, either party may request in writing, within seven (7) calendar days thereafter, that the grievance be submitted to an Arbitrator mutually agreed upon by them. The Contractor and the involved Union shall attempt mutually to select an arbitrator, but if they are unable to do so, they shall request the Federal Mediation and Conciliation Service to provide them with a list of seven (7) neutral arbitrators from which the Arbitrator shall be selected. The parties shall alternatively strike arbitrators from the list until one remains, who shall preside at the hearing. The party striking first shall be determined by the flip of a coin. The decision of the Arbitrator shall be final and binding on all parties. The fee and expenses of such Arbitration shall be borne equally by the Contractor and the involved Local Union(s).

(b) Failure of the grieving party to adhere to the time limits established herein shall render the grievance null and void. The time limits established herein may be extended only by written consent of the parties involved at the particular step where the extension is agreed upon. The Arbitrator shall have the authority to make decisions only on issues presented to him or her, and he or she shall not have authority to change, amend, add to or detract from any of the provisions of this Agreement.

Section 4. The Project Contractor and Owner shall be notified of all actions at Steps 2 and 3 and shall, upon their request, be permitted to participate in all proceedings at these steps.

ARTICLE X

JURISDICTIONAL DISPUTES

Section 1. The assignment of work will be solely the responsibility of the Contractor performing the work involved; and such work assignments will be in accordance with the Plan for the Settlement of Jurisdictional Disputes in the Construction Industry (the "Plan") or any successor Plan.

Section 2. All jurisdictional disputes on this Project, between or among Building and Construction Trades Unions and employers, parties to this Agreement, shall be settled and adjusted according to the present Plan established by the Building and Construction Trades Department or any other plan or method of procedure that may be adopted in the future by the Building and Construction Trades Department. Decisions rendered shall be final, binding and conclusive on the Contractors and Unions parties to this Agreement.

Section 3. All jurisdictional disputes shall be resolved without the occurrence of any strike, work stoppage, or slow-down of any nature, and the Contractor's assignment shall be adhered to until the dispute is resolved. Individuals violating this section shall be subject to immediate discharge.

Section 4. Each Contractor will conduct a pre-job conference with the appropriate Building and Construction Trades Council prior to commencing work. The Project Contractor and the Owner will be advised in advance of all such conferences and may participate if they wish.

ARTICLE XI

SUBCONTRACTING

The Project Contractor agrees that neither it nor any of its contractors or subcontractors will subcontract any work to be done on the Project except to a person, firm or corporation who is or agrees to become party to this Agreement. Any contractor or subcontractor working on the Project shall, as a condition to working on said Project, become signatory to and perform all work under the terms of this Agreement.

ARTICLE XII
HELMETS TO HARDHATS

Section 1. The Employers and Unions recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The Employers and Unions agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter “Center”) and the Center’s “Helmets to Hardhats” program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

Section 2. The Unions and Employers agree to coordinate with the Center to create and maintain an integrated database of veterans interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

ARTICLE XIII
LABOR HARMONY CLAUSE

The contractor shall furnish labor that can work in harmony with all other elements of labor employed on the Project and shall submit a labor harmony plan to demonstrate how this will be done. “Harmony” shall include the provision of labor that will not, either directly or indirectly, cause or give rise to any work disruptions, slowdowns, picketing, stoppages, or any violence or harm to any person or property while performing any work, or activities incidental thereto at the Project. The labor harmony plan should include the company’s labor management policies, collective bargaining agreements if any and their expiration dates, past labor relations history, a listing of activities anticipated under this contract that may potentially cause friction with on-site workers, and procedures the company will undertake to eliminate this friction.

The contractor agrees that it shall require every lower-tier subcontractor to provide labor that will work in harmony with all other elements of labor employed in the work, and will include the provisions contained in the paragraph above, in every lower-tier subcontract let for work under this contract.

The requirement to provide labor that can work in harmony with all other elements of labor employed in the work throughout the contract performance is a material element of this contract. Failure by the contractor or any of its lower-tier subcontractors to comply with this requirement shall be deemed a material breach of the contract which will subject the contractor to all rights and remedies the Owner or Project Contractor may have, including without limitation the right to terminate the contract.

ARTICLE XIV

NO DISCRIMINATION

Section 1. The Contractor and Union agree that they will not discriminate against any employee or applicant for employment because of his or her membership or non-membership in a Union or based upon race, color, religion, sexual preference, gender identification, national origin or age in any manner prohibited by law or regulation.

Section 2. Any complaints regarding application of the provisions of Section 1, should be brought to the immediate attention of the involved Contractor for consideration and resolution.

Section 3. The use of the masculine or feminine gender in this Agreement shall be construed as including all gender identification.

ARTICLE XV

SAVINGS AND SEPARABILITY

It is not the intention of the parties to violate any laws governing the subject matter of this Agreement. The parties hereto agree that in the event any provisions of the Agreement are finally held or determined to be illegal or void as being in contravention of any applicable law, the remainder of the Agreement shall remain in full force and effect unless the part or parts so found to be void are wholly inseparable from the remaining portions of this Agreement. Further, the Contractor and Union agree that if and when any and all provisions of this Agreement are finally held or determined to be illegal or void by a Court of competent jurisdiction, the parties will promptly enter into negotiations concerning the substance affected by such decision for the purpose of achieving conformity with the requirements of an applicable law and the intent of the parties hereto.

ARTICLE XVI

DURATION OF THE AGREEMENT

The Project Labor Agreement shall continue in effect for the duration of the Project construction work described in Article II hereof. Construction of any phase, portion, section or segment of the project shall be deemed complete when such phase, portion, section or segment has been turned over to the Owner and has received the final acceptance from the Owner's representative.

Since there are provisions herein for no strikes or lockouts in the event any changes are negotiated and implemented under a Local Area Agreement during the term of this Agreement, the Contractor agrees that, except as specified herein, such changes shall be recognized and shall apply retroactively to the termination date in the particular Local Agreement involved. Each Contractor which has a Local Agreement with a Union at the time that its contract at the project commences shall continue it in effect with each said Union so long as the Contractor remains on the project. In the event any such Local Area Agreement expires, the Contractor shall abide by all of the terms of the expired Local Agreement until agreement is reached on a new Local Agreement, with any changes being subject to the provisions of this Agreement.

The Union agrees that there will be no strikes, work stoppages, sympathy actions, picketing, slowdowns or other disruptive activity affecting the Project by any Union involved in the negotiation of a Local Area Agreement nor shall there be any lockout on this Project affecting the Union during the course of such negotiations.

[The remainder of this page intentionally left blank. Signature page to follow].

TEMPLATE

IN WITNESS WHEREOF, the parties have hereunto set their hands on the date of attestation shown below.

DULUTH BUILDING AND
CONSTRUCTION TRADES COUNCIL

Click or tap here to enter text.

By: _____

Its: _____
(Printed Name/Title)

Date: _____

By: _____

Its: _____
(Printed Name/Title)

Date: _____

Phone No.: _____

CITY OF DULUTH

By: _____
Mayor

Attest:

City Clerk

Date: _____

City Auditor

City Attorney

**SUBCONTRACTOR'S
AGREEMENT TO BE BOUND
PROJECT LABOR AGREEMENT**

The undersigned EMPLOYER (subcontractor) agrees that it has reviewed a copy of the Project Labor Agreement for the _____ Project located in Duluth, Minnesota, with the Duluth Building and Construction Trades Council and further agrees to become a party to and bound to the foregoing Agreement.

This form is to be completed by subcontractors and submitted to the Project Contractor. Project Contractor shall retain and submit to City of Duluth or Duluth Building and Construction Trades Council upon request.

Attest:

SIGNED FOR THE EMPLOYER:

Dated: _____

Company Name

Company Address

Phone No., Job Site and/or Office

Fax No.

Signature

Title

SCHEDULE “A”

For a copy of the current Local Area Collective Bargaining Agreement referenced in Article II, Section 9 of the PLA please contact directly the Local Union representing the craft for the work to be performed (see attached contact list) or contact the Duluth Building and Construction Trades Council.

- A-1 Asbestos Workers Local 49
- A-2 Boilermakers Local 647
- A-3 BAC Local 1 Chapter 3 Duluth and Iron Range
- A-4 Carpenters Local 361
- A-5 Cement Masons/Plasters Local 633
- A-6 Elevator Constructors Local 9
- A-7 IBEW Local 242
- A-8 Iron Workers Local 512
- A-9 Laborers Local 1091
- A-10 Millwrights Local 1348
- A-11 Operating Engineers Local 49
- A-12 Painters & Allied Trades Local 106
- A-13 Plumbers & Fitters Local 11
- A-14 Roofers Local 96
- A-15 Sheet Metal Workers Local 10
- A-16 Sprinkler Fitters Local 669
- A-17 Teamsters Local 346

Affiliated AFL-CIO

DULUTH BUILDING AND CONSTRUCTION TRADES COUNCIL

2002 LONDON ROAD

LABOR CENTER

DULUTH, MINN. 55812



Officers

Craig Olson

President

Darrell Godbout

Vice President

Dan Olson

Secretary

Jeff Daveau

Treasurer

ASBESTOS WORKERS LOCAL 49

Dave Cartwright

2002 London Road #210

Duluth, MN 55812

(218) 724-3223 / Fax# 724-1870

dave@insulatorslocal49.org

BOILERMAKERS LOCAL 647

Bill Polchow

1007 NW 4th Street, Ste C

Grand Rapids, MN 55744

(218) 326-2522 / Fax# SAME

bpolchow647@outlook.com

BAC LOCAL #1 CHAPTER 3

DULUTH & IRON RANGE

Stan (Ogie) Paczynski

2002 London Road #100

Duluth, MN 55812

(218) 724-8374 / Fax# 724-8341

spaczynski@bac1mn-nd.org

Boilermakers #647

Bricklayers #1

Carpenters #361

Cement Masons #633

Elevator #9

IBEW #242

Insulators #49

Ironworkers #512

Laborers #1091

Millrights #1348

Operators #49

Painters #106

Pipelitters #11

Roofers #96

Sheetmetal #10

Sprinklerfitters #669

Teamsters #346

CARPENTERS LOCAL 361

Chris Hill

5238 Miller Trunk Hwy

Hermantown, MN 55811

(218) 724-3297 / Fax# 724-8536

chill@ncsrcc.org

CEMENT MASONS LOCAL 633

Michael Syversrud

2002 London Road #112

Duluth, MN 55812

(218) 724-2323 / Fax# 724-2472

mikesy@local633.org

ELEVATOR CONSTRUCTORS LOCAL 9

Dave Aaserud

433 Little Canada Rd E

Little Canada, MN 55117

(651) 287-0817 / Fax# 287-0820

d.aaserud@local9.com

IBEW LOCAL 242

Don Smith

2002 London Road #111

Duluth, MN 55812

(218) 728-6895 / Fax# 728-1965

dsmith1242@unions-america.com

IRON WORKERS LOCAL 512

Darrell Godbout, *Vice President*

3752 Midway Road

Hermantown, MN 55810

(218) 724-5073 / Fax# 724-1525

darrell@iron512.com

LABORERS LOCAL 1091

Dan Olson, *Secretary*

2002 London Road #119

Duluth, MN 55812

(218) 728-5151 / Fax# 728-2431

laborers@local1091.com

MILLRIGHTS & MACHINERY ERECTORS LOCAL 1348

Wayne Nordin

726 4th Street N

Virginia, MN 55792

(218) 741-6314 / Fax# 741-6017

wnordin@ncsrcc.org

OPERATING ENGINEERS LOCAL 49

Eric Gulland & Mike Parrott

2002 London Road #116

Duluth, MN 55812

(218) 724-3840 / Fax# 728-1441

edgulland@local49.org

mwparrott@local49.org

PAINTERS LOCAL 106

Craig Olson, *President*

2002 London Road #106

Duluth, MN 55812

(218) 724-6466 / Fax# 724-7359

president@duluthbuildingtrades.com

PLUMBERS & FITTERS LOCAL 11

Jeff Daveau, *Treasurer*

4402 Airpark Boulevard

Duluth, MN 55811

(218) 727-2199 / Fax# 727-2298

jeff@ualocal11.com

ROOFERS LOCAL 96

Vance Anderson

1145 Villa Vista Circle

Cromwell MN 55726

(218) 644-1096 / Fax# SAME

valocal96@yahoo.com

SHEET METAL WORKERS LOCAL 10

Doug Christy

6279 Industrial Road

Saginaw, MN 55779

(218) 724-6873 / Fax# SAME

dchristy@smw10.org

SPRINKLER FITTERS LOCAL 669

James Westby

PO Box 398

Mabel, MN 55954

(507) 493-5671 / Fax# 493-5481

westby@mabeltel.coop

TEAMSTERS LOCAL 346

Rod Aistead

2802 West 1st Street

Duluth, MN 55806

(218) 628-1034 / Fax# 628-0246

local@teamsters346.com



DEPARTMENT OF PUBLIC WORKS & UTILITIES
ENGINEERING DIVISION

APPENDIX D
STANDARD DETAIL DRAWINGS

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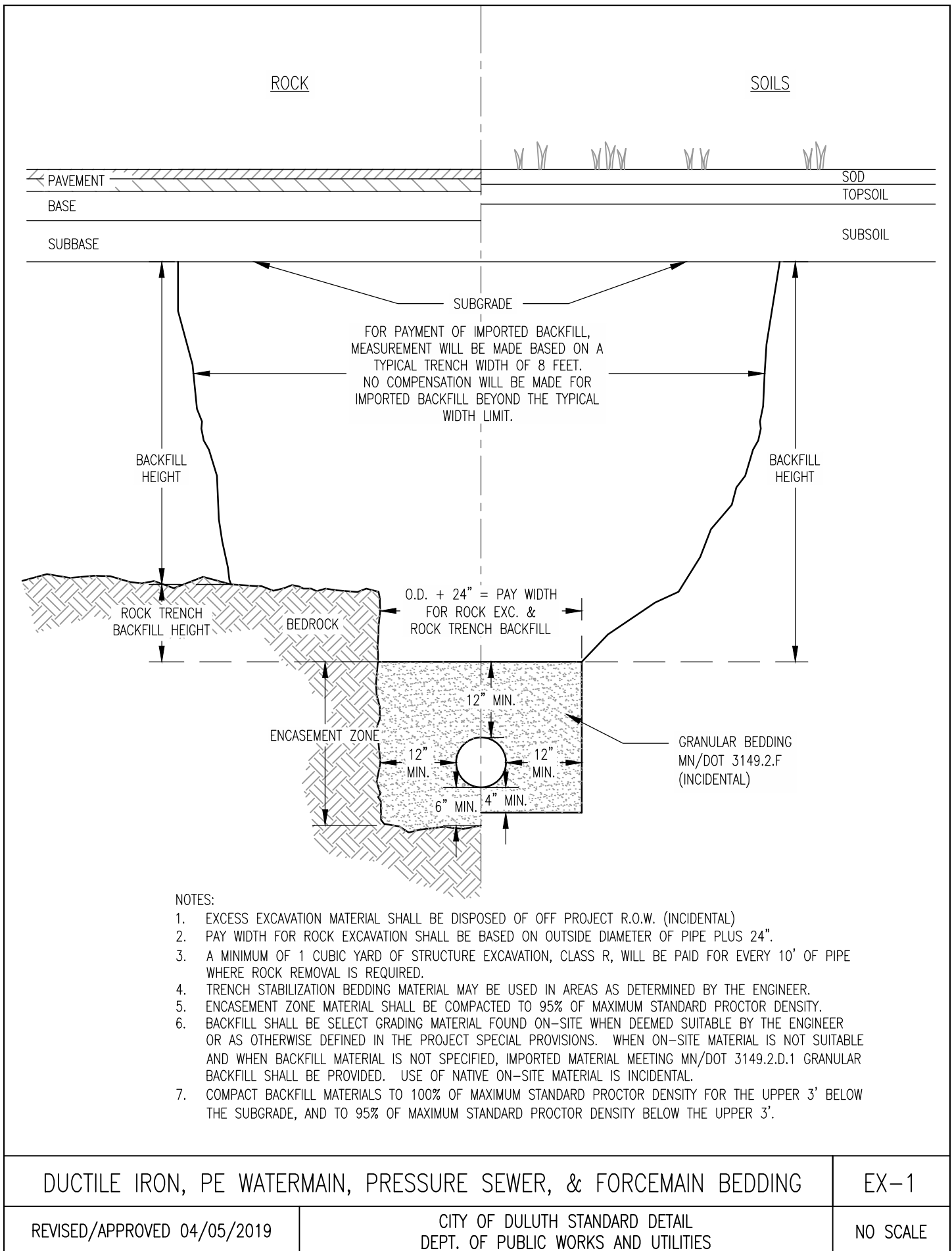
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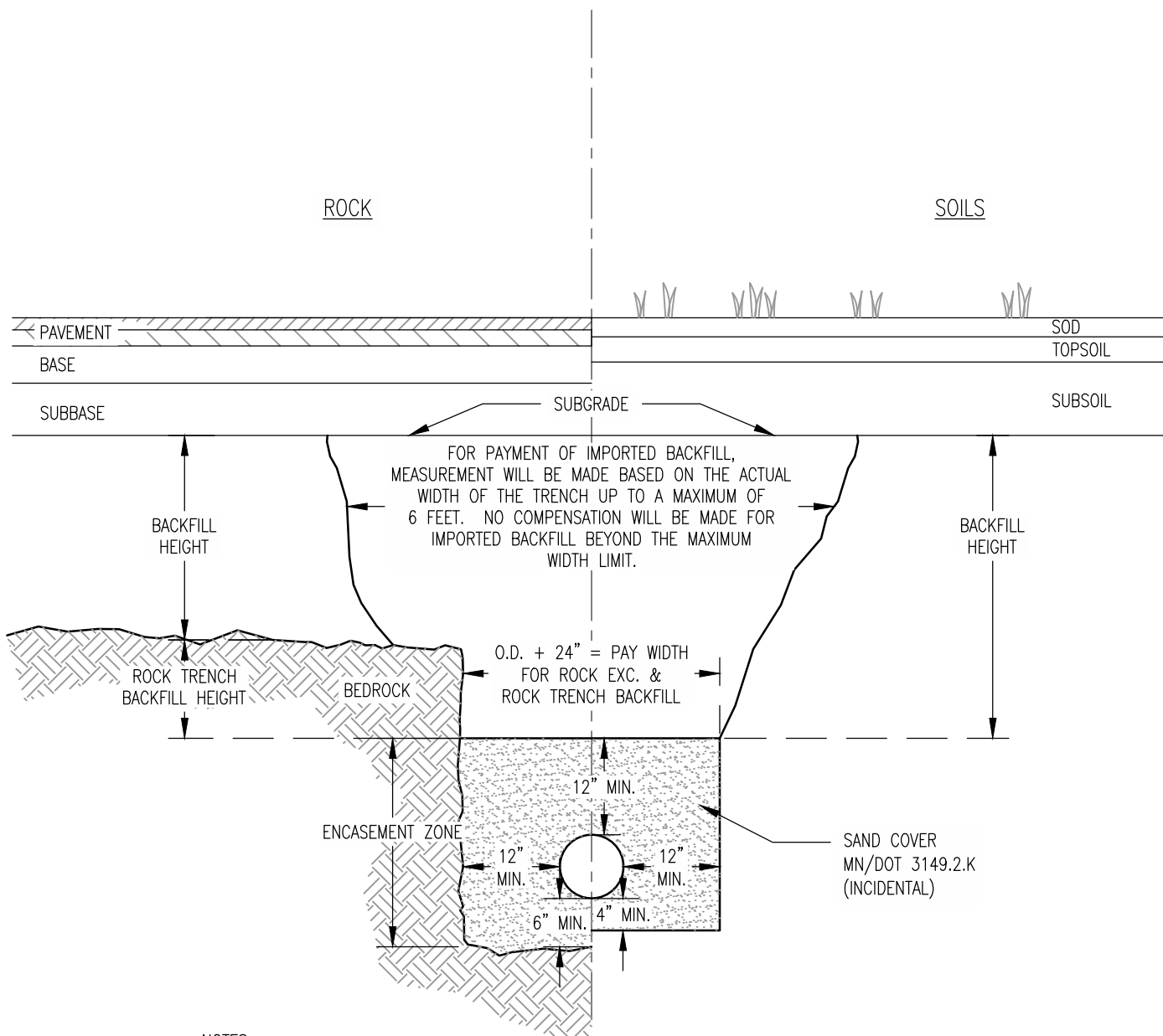
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NOTES:

1. EXCESS EXCAVATION MATERIAL SHALL BE DISPOSED OF OFF PROJECT R.O.W. (INCIDENTAL)
2. PAY WIDTH FOR ROCK EXCAVATION SHALL BE BASED ON OUTSIDE DIAMETER OF PIPE PLUS 24".
3. A MINIMUM OF 1 CUBIC YARD OF STRUCTURE EXCAVATION, CLASS R, WILL BE PAID FOR EVERY 10' OF PIPE WHERE ROCK REMOVAL IS REQUIRED.
4. TRENCH STABILIZATION BEDDING MATERIAL MAY BE USED IN AREAS AS DETERMINED BY THE ENGINEER.
5. ENCASEMENT ZONE MATERIAL SHALL BE COMPACTED TO 95% OF MAXIMUM STANDARD PROCTOR DENSITY.
6. BACKFILL SHALL BE SELECT GRADING MATERIAL FOUND ON-SITE WHEN DEEMED SUITABLE BY THE ENGINEER OR AS OTHERWISE DEFINED IN THE PROJECT SPECIAL PROVISIONS. WHEN ON-SITE MATERIAL IS NOT SUITABLE AND WHEN BACKFILL MATERIAL IS NOT SPECIFIED, IMPORTED MATERIAL MEETING MN/DOT 3149.2.D.1 GRANULAR BACKFILL SHALL BE PROVIDED. USE OF NATIVE ON-SITE MATERIAL IS INCIDENTAL.
7. COMPACT BACKFILL MATERIALS TO 100% OF MAXIMUM STANDARD PROCTOR DENSITY FOR THE UPPER 3' BELOW THE SUBGRADE, AND TO 95% OF MAXIMUM STANDARD PROCTOR DENSITY BELOW THE UPPER 3'.

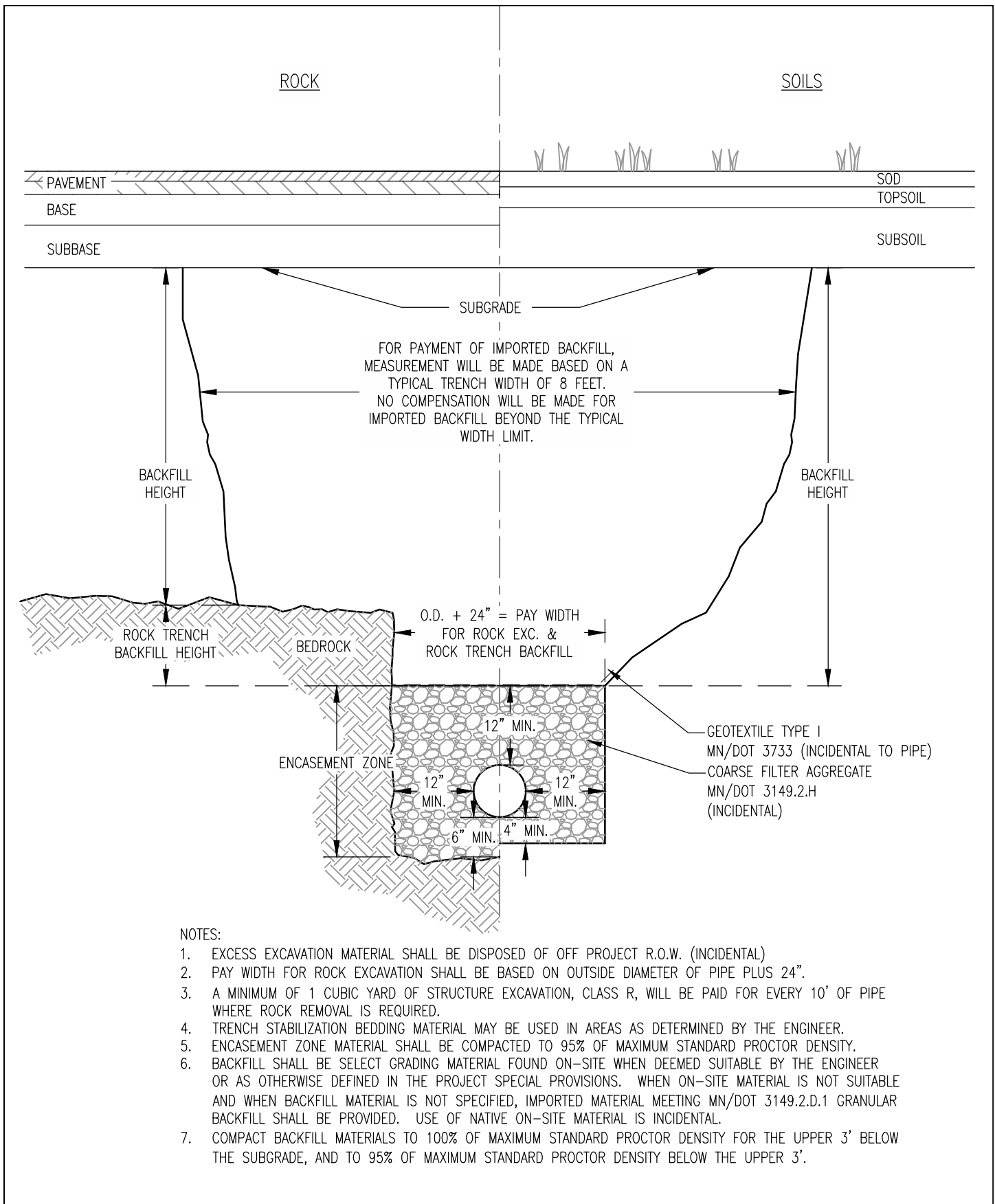
ALL STEEL & 4" AND LARGER PE GAS MAIN BEDDING

EX-2

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



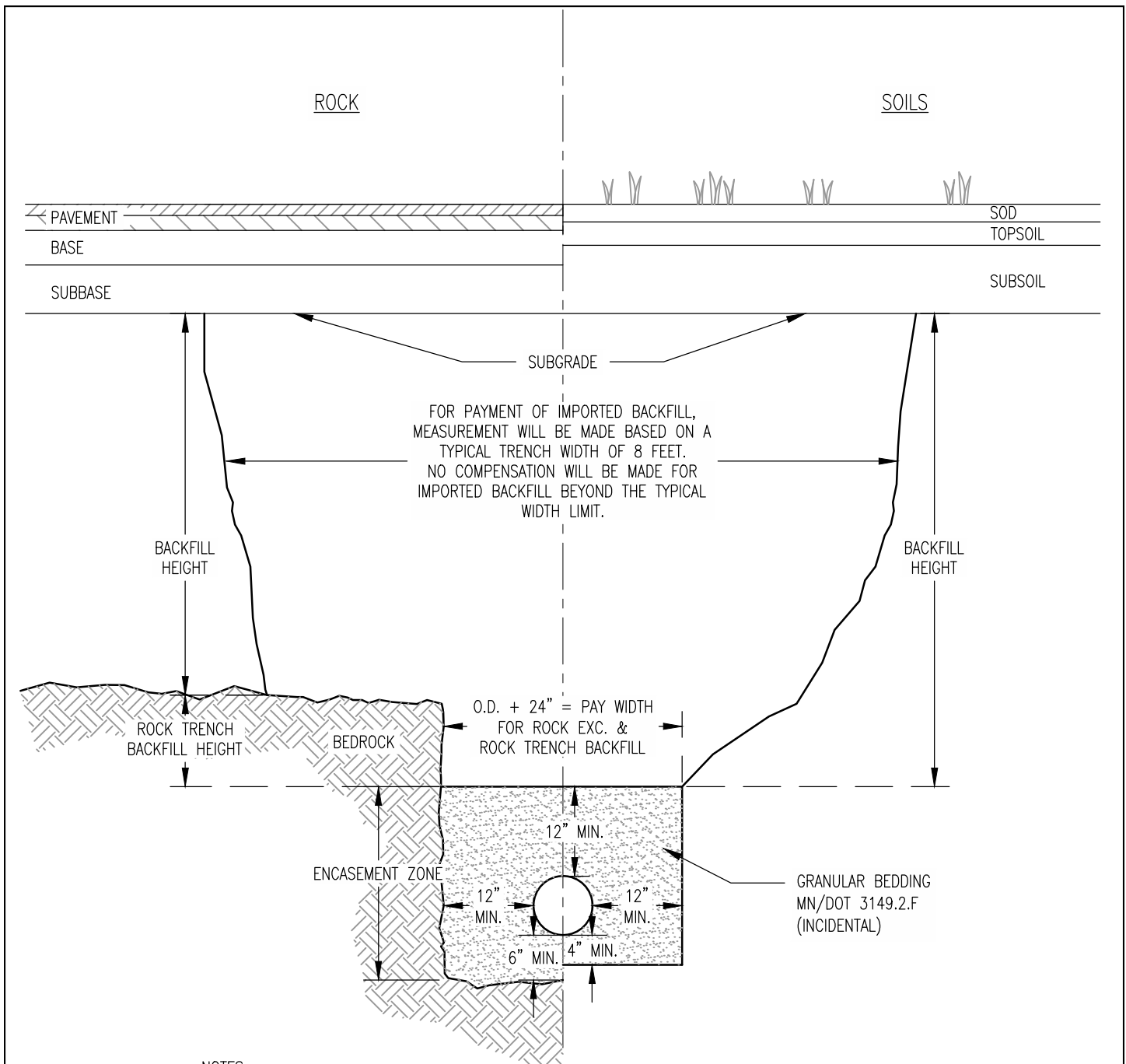
PVC AND CORRUGATED POLYETHYLENE SEWER PIPE BEDDING

EX-3

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. EXCESS EXCAVATION MATERIAL SHALL BE DISPOSED OF OFF PROJECT R.O.W. (INCIDENTAL)
2. PAY WIDTH FOR ROCK EXCAVATION SHALL BE BASED ON OUTSIDE DIAMETER OF PIPE PLUS 24".
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5. ENCASEMENT ZONE MATERIAL SHALL BE COMPACTED TO 95% OF MAXIMUM STANDARD PROCTOR DENSITY.
6. BACKFILL SHALL BE SELECT GRADING MATERIAL FOUND ON-SITE WHEN DEEMED SUITABLE BY THE ENGINEER OR AS OTHERWISE DEFINED IN THE PROJECT SPECIAL PROVISIONS. WHEN ON-SITE MATERIAL IS NOT SUITABLE AND WHEN BACKFILL MATERIAL IS NOT SPECIFIED, IMPORTED MATERIAL MEETING MN/DOT 3149.2.D.1 GRANULAR BACKFILL SHALL BE PROVIDED. USE OF NATIVE ON-SITE MATERIAL IS INCIDENTAL.
7. COMPACT BACKFILL MATERIALS TO 100% OF MAXIMUM STANDARD PROCTOR DENSITY FOR THE UPPER 3' BELOW THE SUBGRADE, AND TO 95% OF MAXIMUM STANDARD PROCTOR DENSITY BELOW THE UPPER 3'.

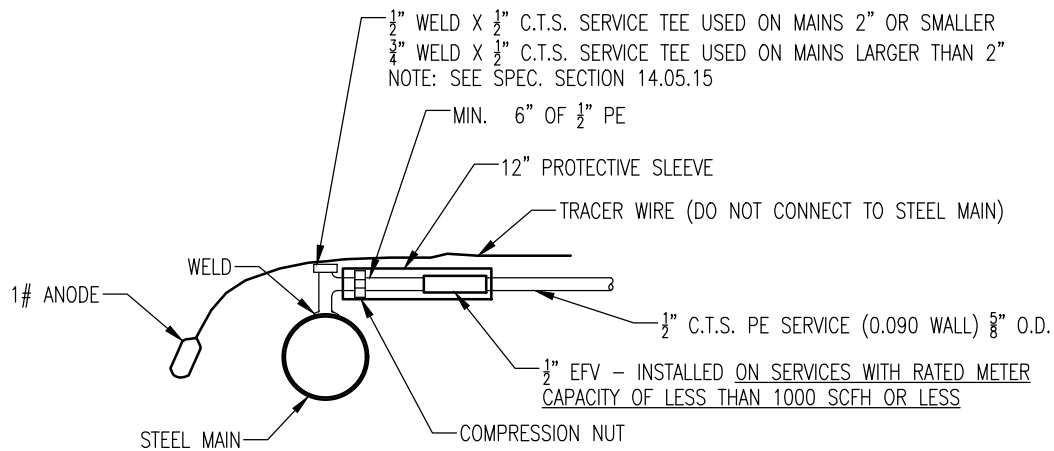
CONCRETE STORM SEWER BEDDING

EX-4

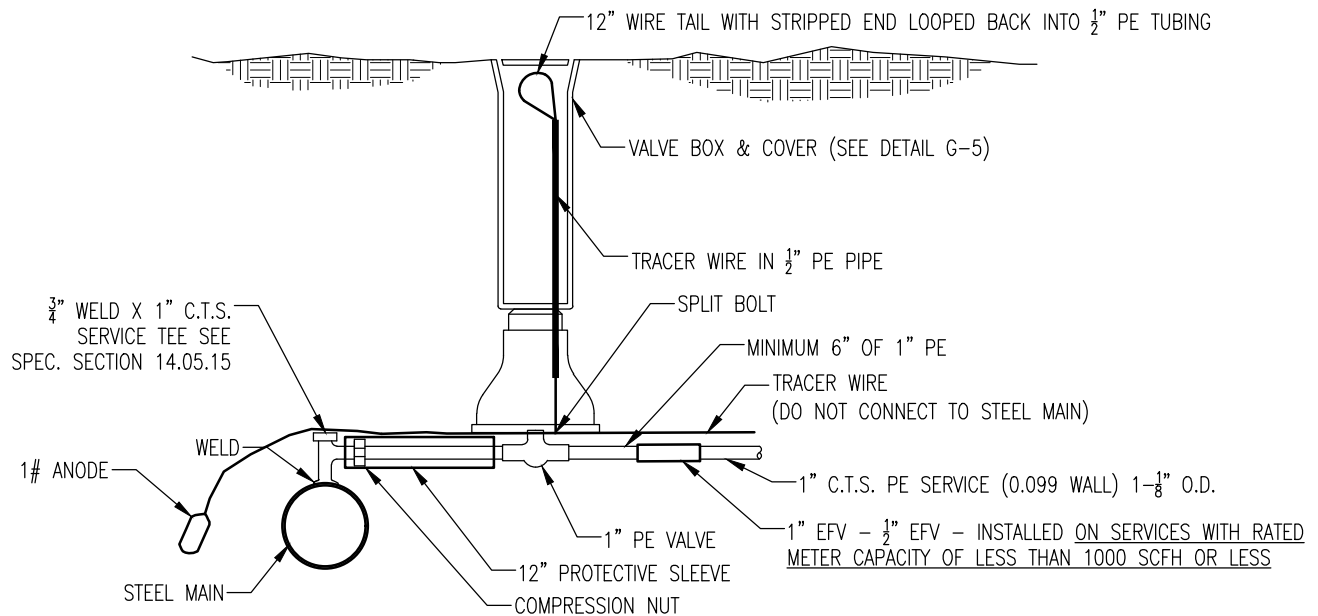
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



1/2" C.T.S. PE SERVICE ON STEEL MAIN



1" C.T.S. PE SERVICE ON STEEL MAIN

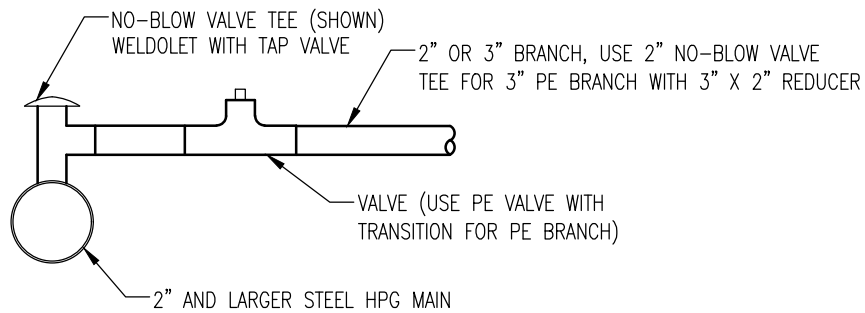
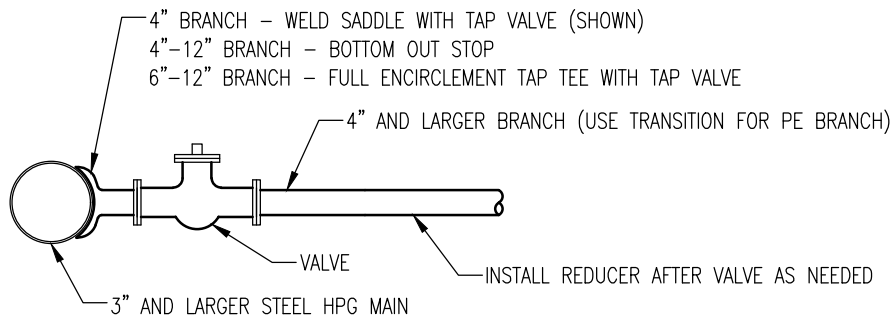
STEEL TO PE SERVICE CONNECTION

G-2

REVISED/APPROVED 05/01/2018

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



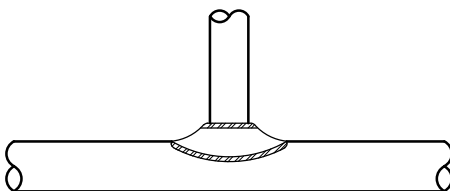
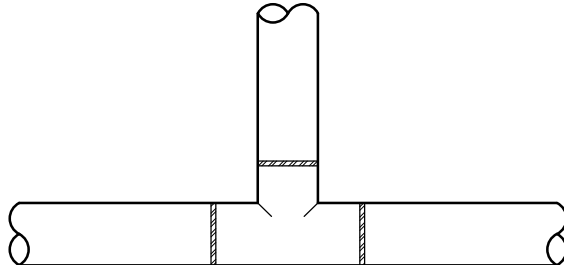
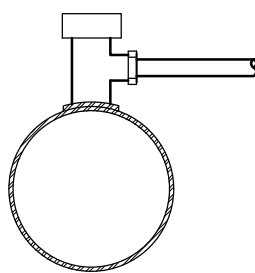
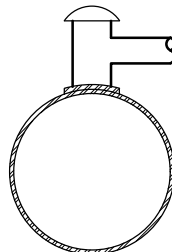
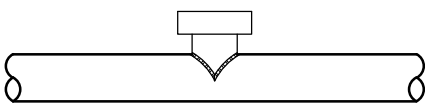
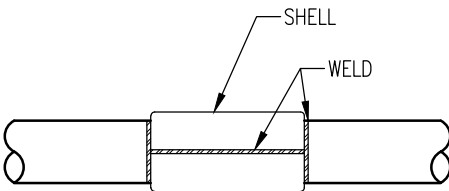
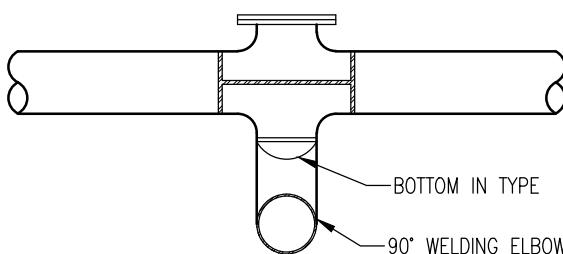
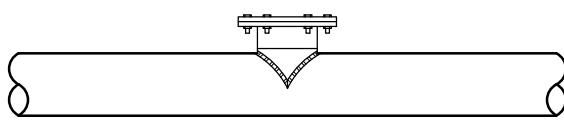
GAS MAIN BRANCH CONNECTIONS TO STEEL MAIN

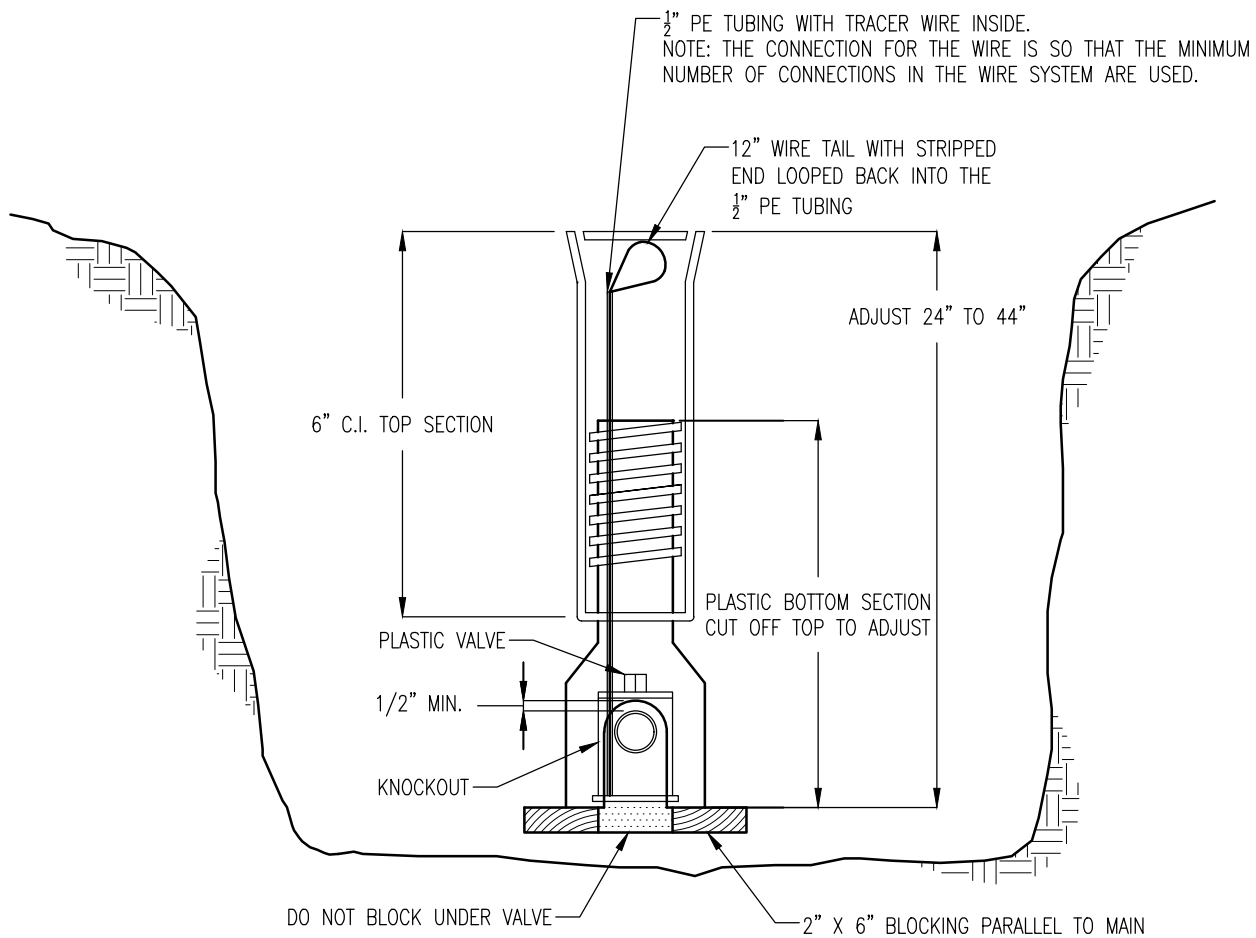
G-3

REVISED/APPROVED 02/07/2018

CITY OF DULUTH STANDARD DETAIL
 DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

REDUCED LATERAL  <u>SADDLE</u>		FULL SIZE OR REDUCED ONE SIZE ONLY  <u>WELDING TEE IN LINE</u>			
 1/2" OR 1" PE <u>1/2" AND 1" TAP TEES</u>		 <u>1", 1-1/2", 2" NO-BLOW TEE</u>			
 <u>MUELLER STOP - 2" & 3" RUBBER PLUG</u>		 <u>HALF SOLE REPAIR</u>		 SHELL WELD <u>PUMPKIN ENCIRCLEMENT</u>	
MUELLER LINE STOP  BOTTOM IN TYPE 90° WELDING ELBOW IF USING BOTTOM-OUT TYPE <u>MUELLER STOP</u> <u>4"-6"-8"-10"-12"</u> (STEEL PLUG)			T.D. WILLIAMSON LINE STOP  <u>T.D. WILLIAMSON STOP</u> <u>10" - 12" - 14" - 16"</u>		
TYPICAL WELD JOINTS					
REVISED/APPROVED 02/01/2013		CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES		G-4 NO SCALE	



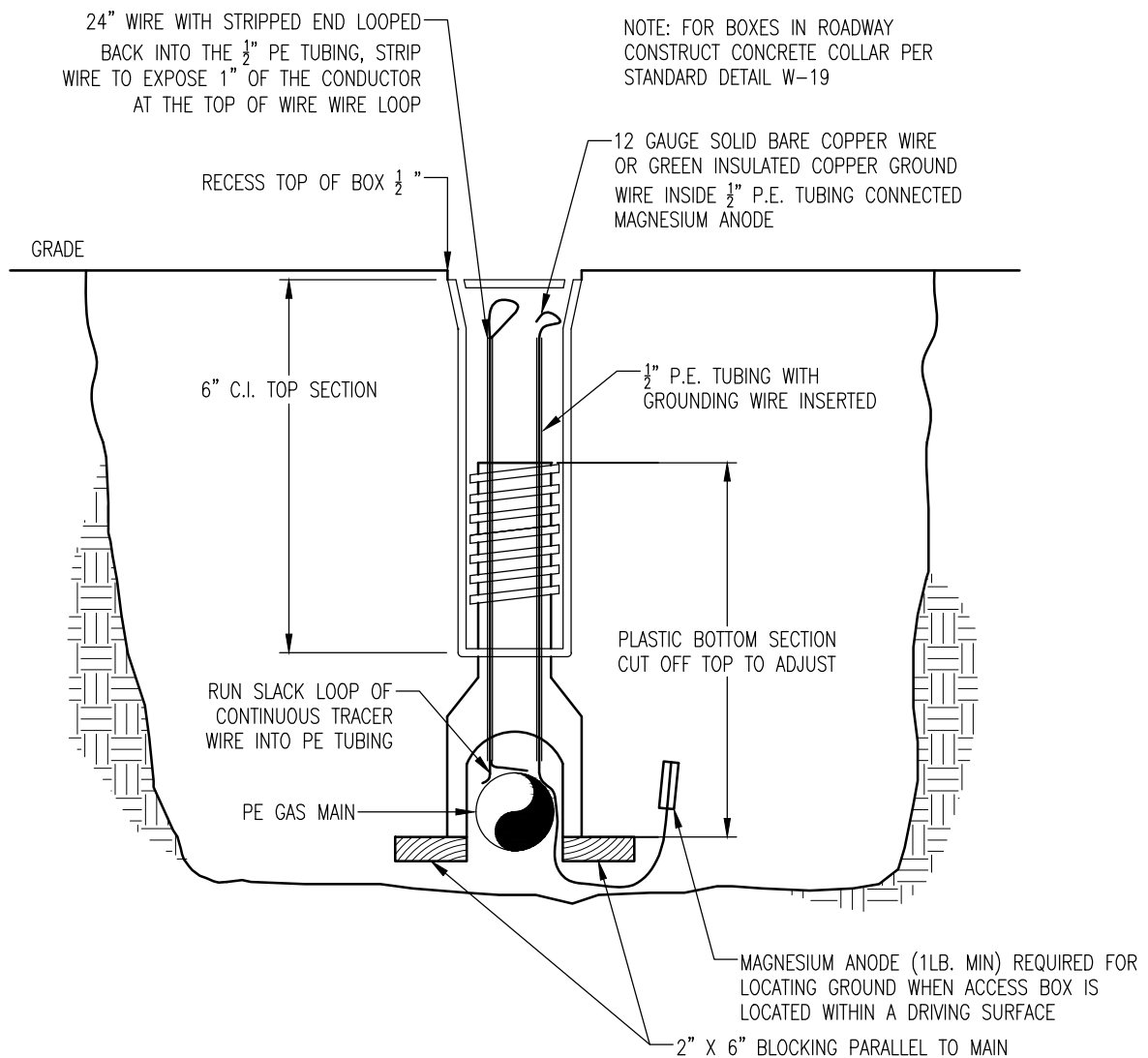
PE VALVE BOX SETTING

G-5

REVISED/APPROVED 05/01/2018

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



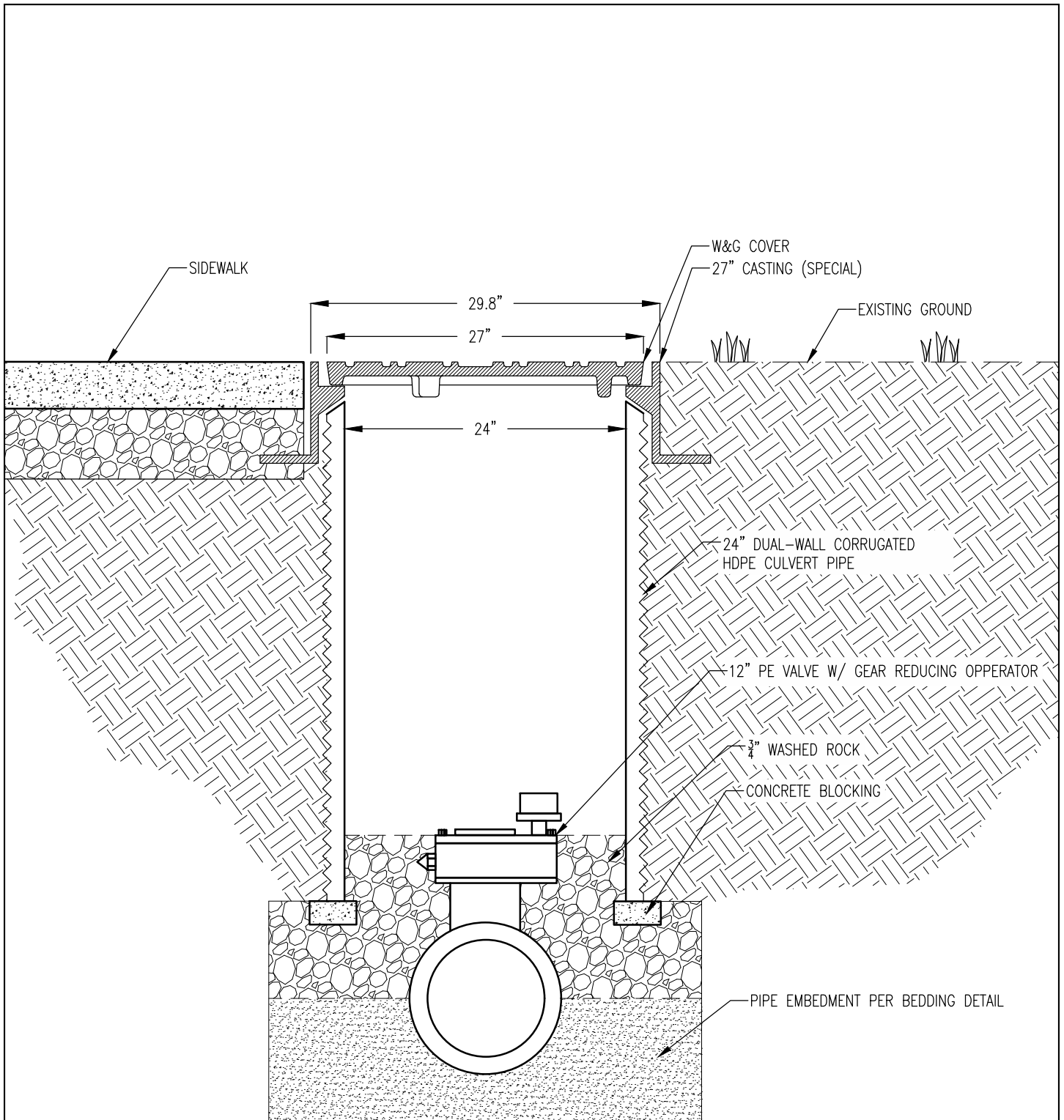
TRACER WIRE ACCESS BOX

G-6

REVISED/APPROVED 05/01/2018

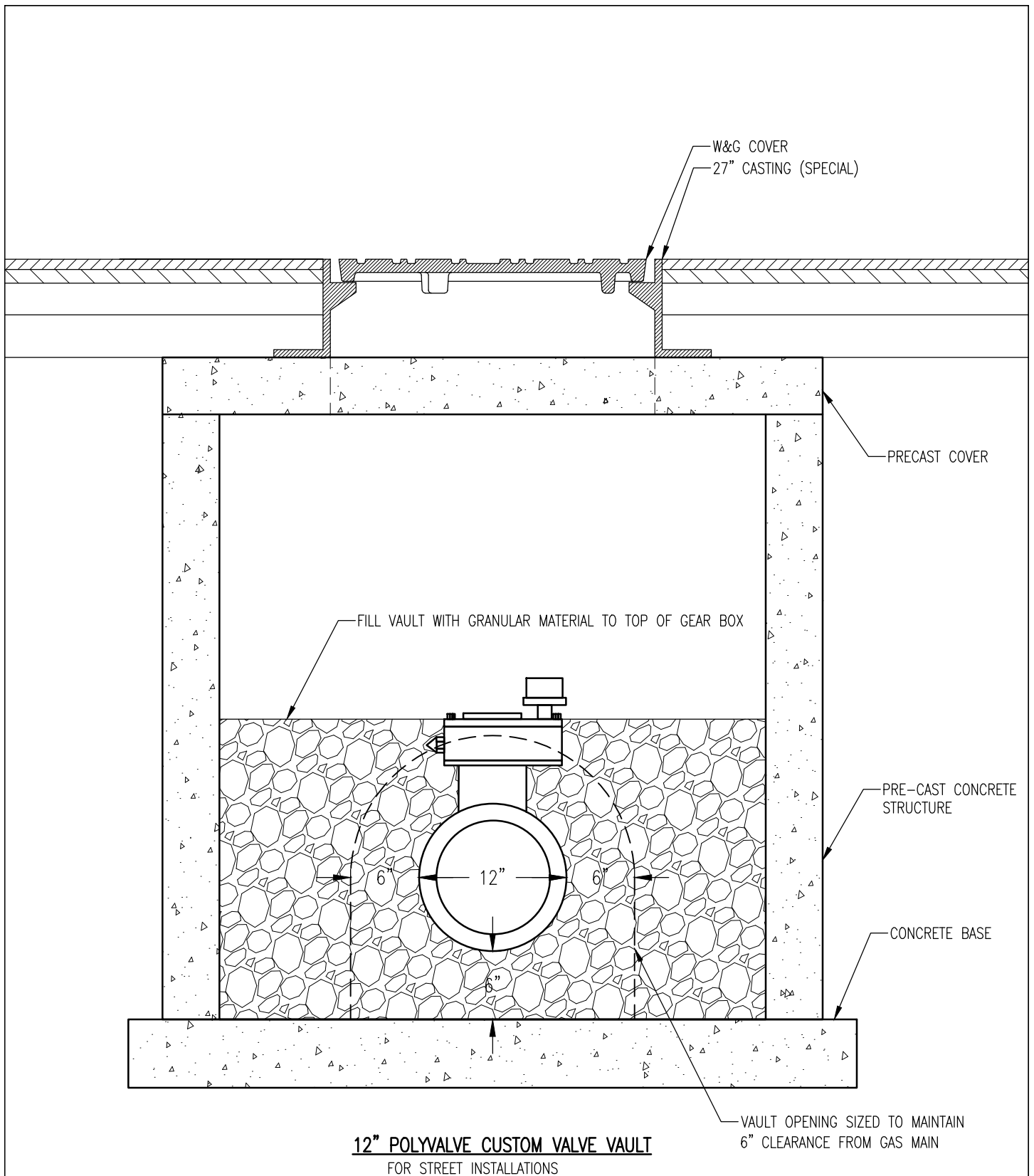
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

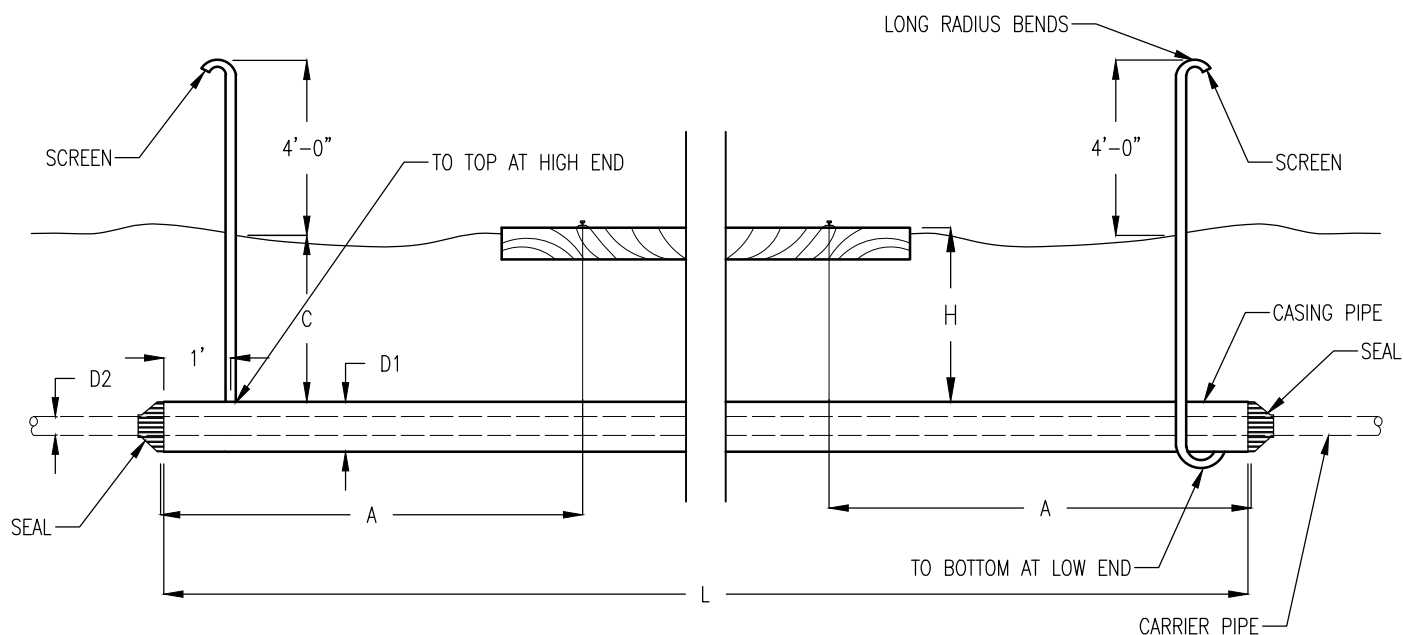


12" POLYVALVE CUSTOM VALVE BOX
FOR TURF AND SIDEWALK APPLICATIONS

12" POLYVALVE CUSTOM VALVE BOX		G-7
REVISED/APPROVED 05/01/2018	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



12" POLYVALVE CUSTOM VALVE VAULT		G-7A
REVISED/APPROVED 05/01/2018	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



DIMENSIONS

A = _____ D1 (CASING DIAMETER) = _____

L = _____ D2 (CARRIER DIAMETER) = _____

H = _____ CASING THICKNESS = _____

C = _____ 1/4" - 6" THRU 16"

5/16" - 18" THRU 20"

3/8" - 22" THRU 24"

MATERIALS

CASING = _____ CARRIER PIPE = _____

CASING SEALS - P.S.I. MODEL "S"
FOR PE, LINK SEAL FOR STEEL PIPE = _____ VENT PIPE - 2" WELDED
STEEL AS DETAILED _____

CASING INSULATORS = _____ OPERATING PRESSURE = _____

GENERAL INFORMATION

RAILROAD COMPANY = _____ CROSSING LOCATION = _____

NUMBER OF TRACKS = _____ METHOD OF INSTALLATION = _____

HP GAS CROSSING AT RAILROAD

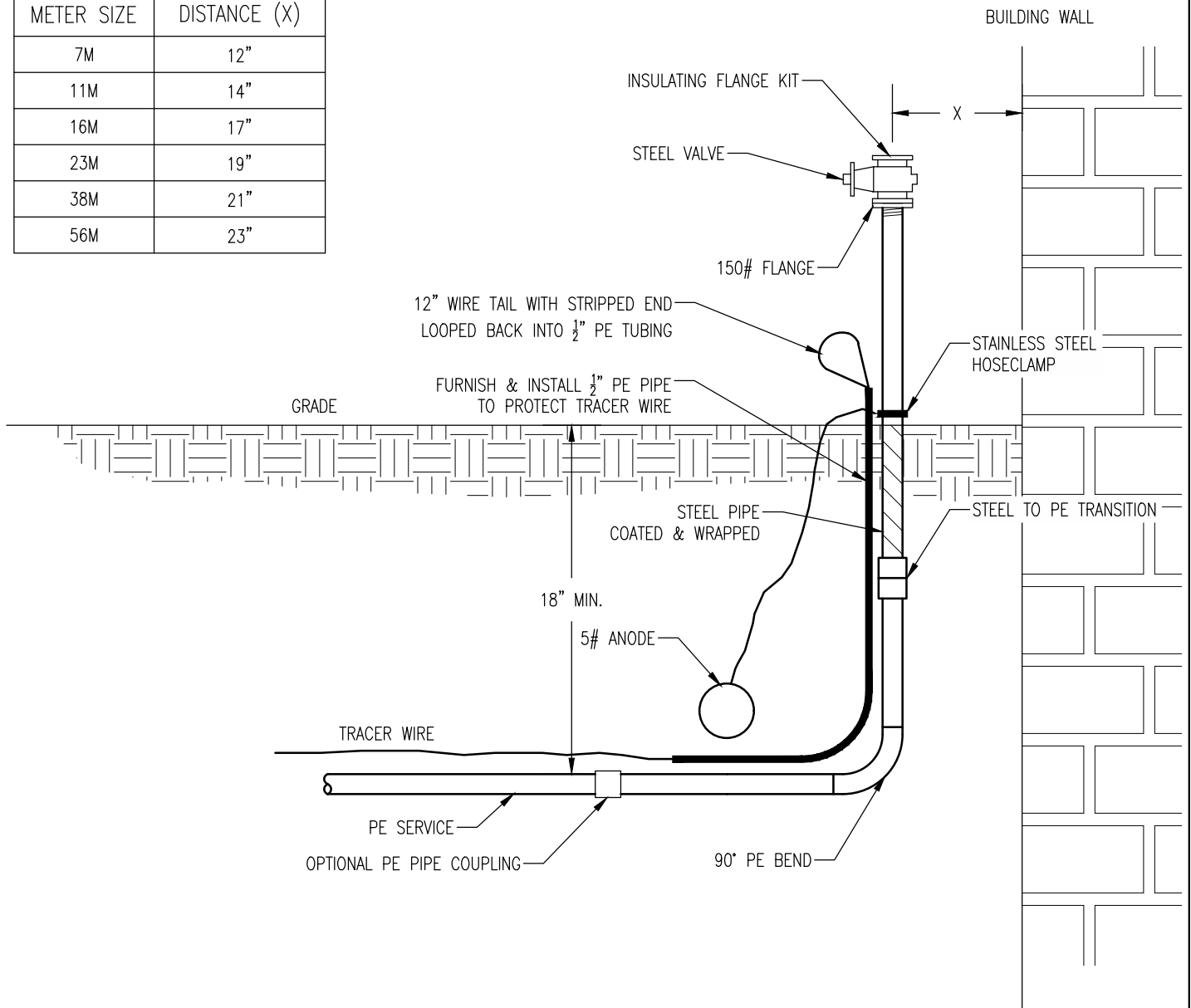
G-8

REVISED/APPROVED 25/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

METER SIZE	DISTANCE (X)
7M	12"
11M	14"
16M	17"
23M	19"
38M	21"
56M	23"



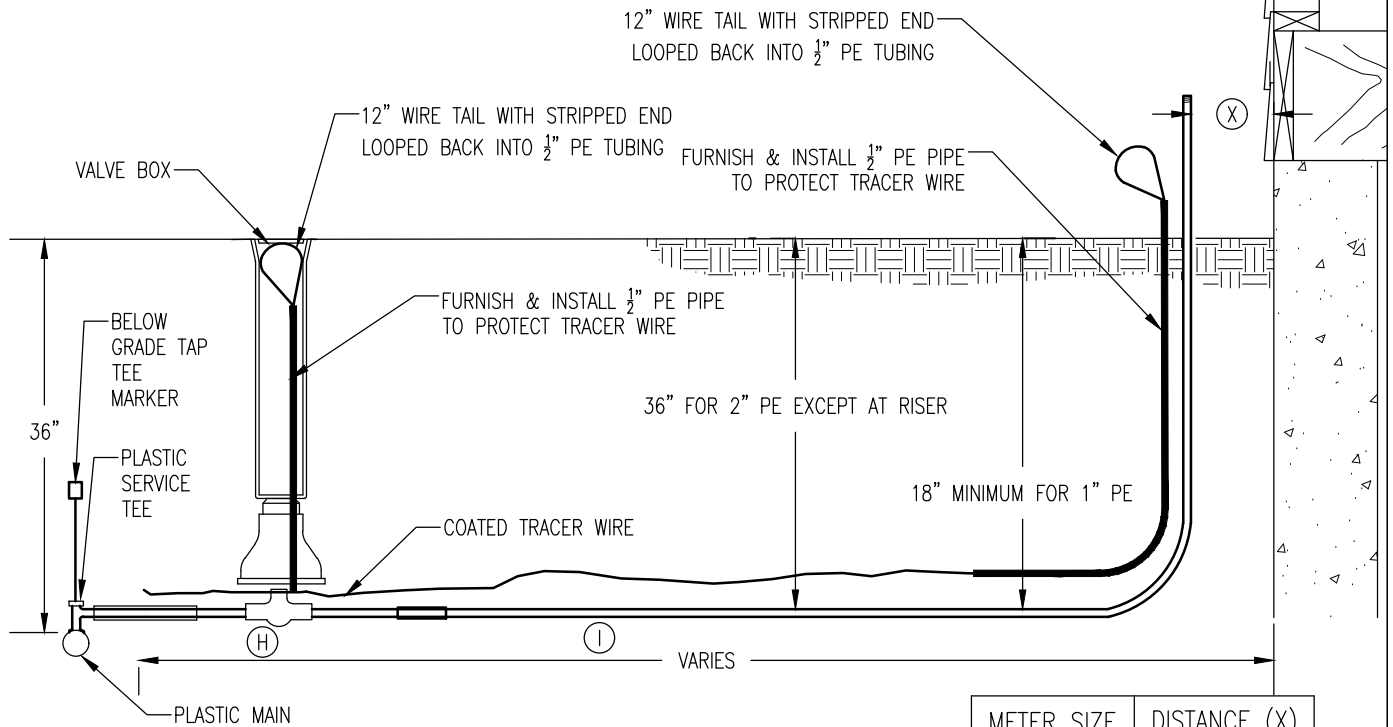
TYPICAL STEEL GAS SERVICE RISER – 3" AND LARGER

G-9

REVISED/APPROVED 05/01/2018

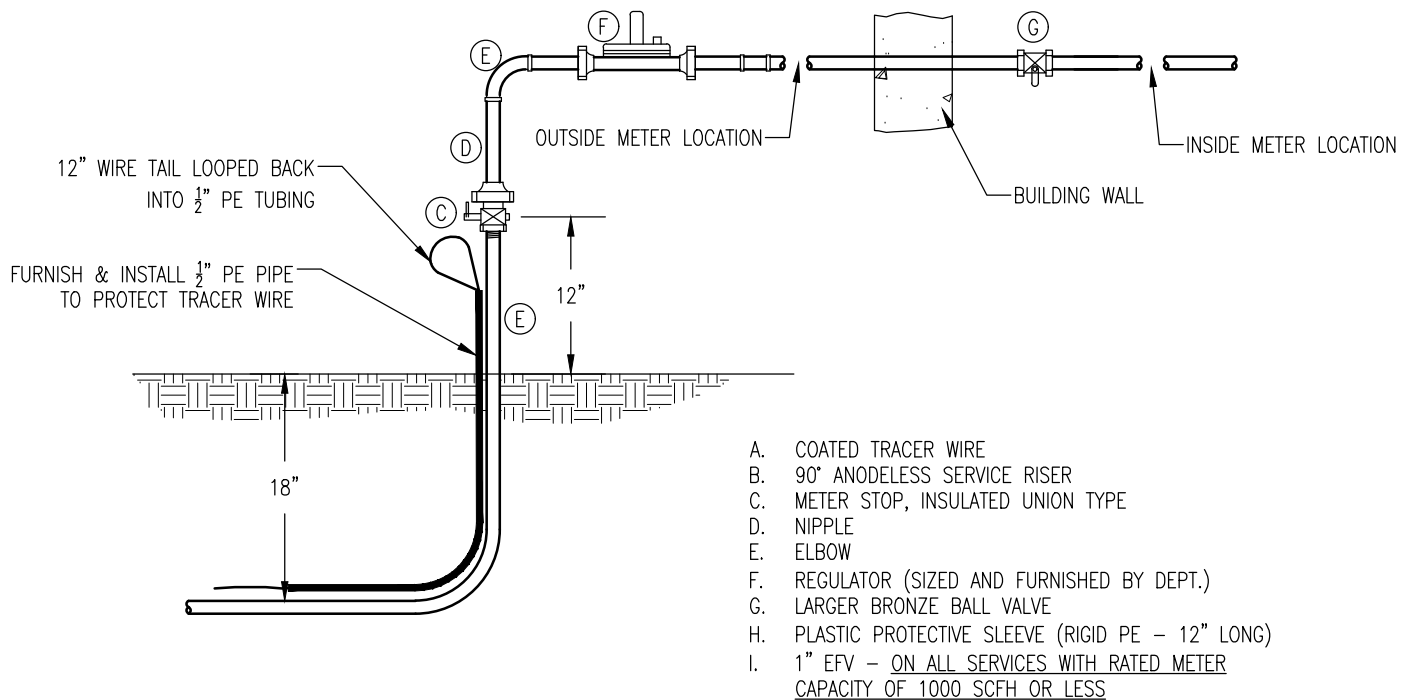
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



1. CONNECT SERVICE TRACER WIRE TO MAIN TRACER WIRE WITH ELECTRIC CONNECTOR.
2. IN MULTIPLE METER SITUATIONS, EACH METER SHALL HAVE A LOCKING VALVE WHICH ALLOWS ANY METER TO BE LOCKED OUT OF SERVICE WHILE THE OTHER REMAIN IN SERVICE.
3. TEST POINTS SHALL BE INSTALLED WITH 1-1/4" OR LARGER REGULATOR ON HIGH AND LOW SIDES USING WELD ON 1/4" COUPLING COMPLETE WITH PETE'S PLUGS.

METER SIZE	DISTANCE (X)
7M	12"
11M	14"
16M	17"
23M	19"



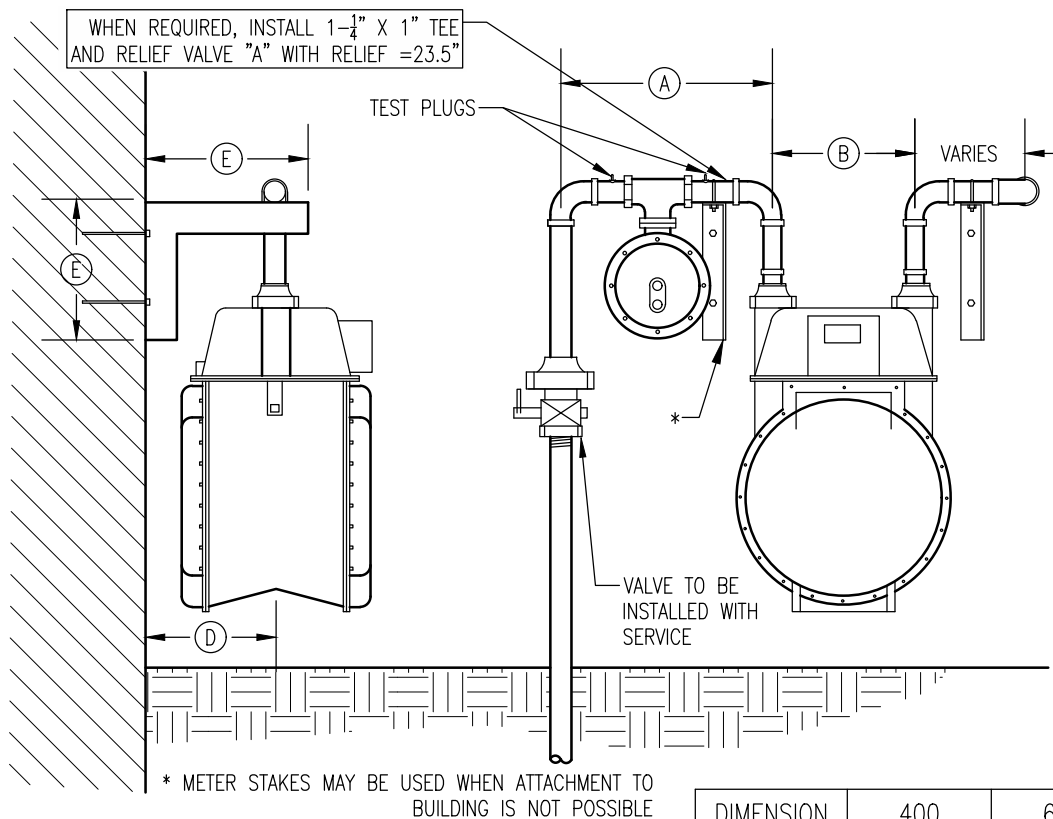
HIGH PRESSURE GAS SERVIE INSTALLATION – 1" CTS & 2" IPS SERVICES

G-11

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTE:

1. EXTEND VENT ONLY WHEN NECESSARY, SEE O & M SECTION 30. DEPT. TO FURNISH: REGULATOR, TEST "PETE'S PLUG" - 2 EACH WITH 1-1/4" NIPPLES, METER WITH SWIVELS AND NUTS, AND ANGLE BRACKETS.
2. SECONDARY RELIEF DEVICE MAY BE REQUIRED.

DIMENSION	400	675	1000
A	17-9/16"	17-11/16"	17-15/16"
B	7"	10"	11"
C	27"	32"	36"
D	9"	9"	9"
E	11"	11"	11"

CUSTOMER LOAD (CFH)	397 TO 600		600 TO 900		900 TO 1428	
METER SIZE	400		675		1000	
METER CONNECTION	1-1/2"		1-1/2"		2"	
PRESSURE LOSS (WC)	1/2" @ 397 CFH		1/2" @ 397 CFH		1/2" @ 397 CFH	
	1" @ 595 CFH		1" @ 918 CFH		1" @ 1428 CFH	
REGULATOR TYPE	ITRON B42R		ITRON B42R		ITRON B42R	
SYSTEM PRESSURE	22#-10#	66#-30#	22#-10#	66#-30#	22#-10#	66#-30#
ORIFICE	1/8"	1/8"	3/16"	1/8"	3/16"	3/16"
CAP @ PIN MAX.	600	1560	1560	1560	2240	2500
CAP @ PIN MIN.	400	765	870	765	1470	2025
VENT MAX. LENGTH 1	130'	20'	18'	20'	0'-3/4", 30'-1"	0'-3/4", 8'-1"
CAPACITY DATA IS FOR SANDARD 7" (WC) DELIVERY PRESSURE						

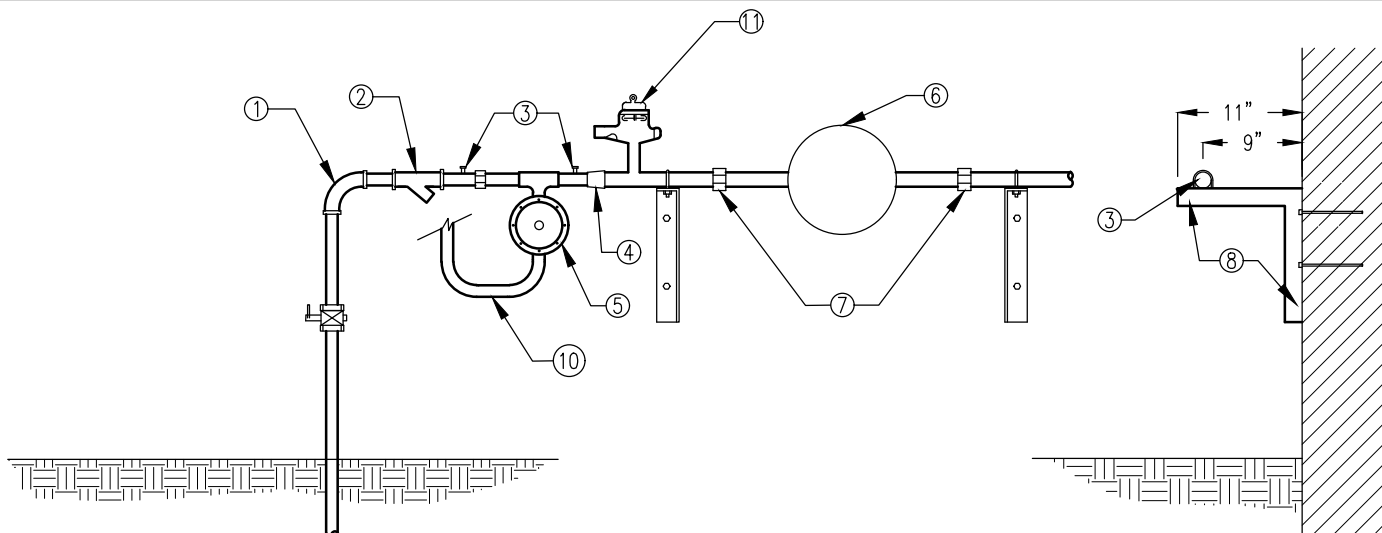
METER INSTALLATION DETAIL - SIZES 400, 675, & 1000

G-11A

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

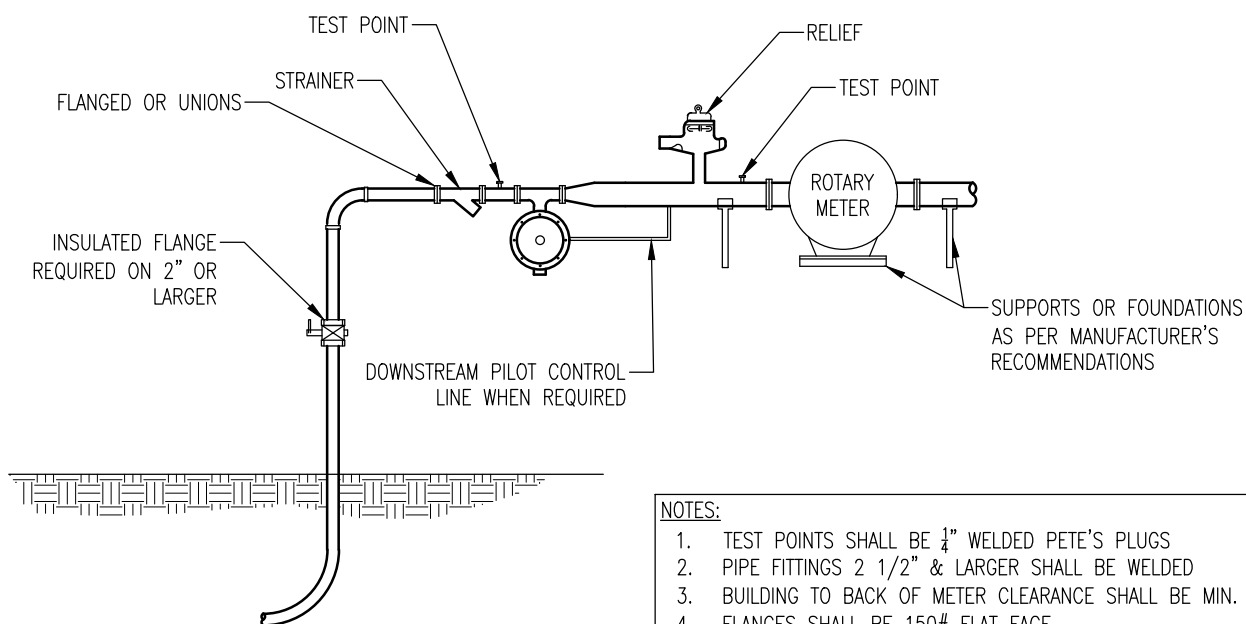
NO SCALE



1. 1-1/4" x 1" REDUCING EL
2. 1-1/4" STRAINER W/BLOWDOWN
3. 1/4" WELD ON COUPLING & PETE'S PLUGS
4. 1-1/2" x 1-1/4" REDUCER
5. B42R OR S202
6. 1.5M125 ROOTS METER
7. 1-1/2" UNIONS
8. 1-1/2" WELDED ANGLE
9. 1-1/2" x 1/4" U-CLAMPS
10. VENT W/RAIN CAP WHERE REQUIRED
11. RELIEF (IF NECESSARY)

1.5M125 ROOTS METER & REGULATOR DETAIL

REGULATOR CAPACITY (CFH)					
P OUT	7" WC			2 PSI*	
ORIFICE	1/8"	3/16"	1/4"	3/16"	1/4"
P IN					
55	1300	—	—	850	1450
35	860	2280	—	1560	1100
15	—	1080	1640	—	—
10	—	—	1470	—	—
*METER PRESSURE 1.83 PSI @ MAX. FLOW					



**TYPICAL DETAIL
3M125 ROOTS METER & LARGER**

NOTES:

1. TEST POINTS SHALL BE 1/4" WELDED PETE'S PLUGS
2. PIPE FITTINGS 2 1/2" & LARGER SHALL BE WELDED
3. BUILDING TO BACK OF METER CLEARANCE SHALL BE MIN. 3"
4. FLANGES SHALL BE 150# FLAT FACE

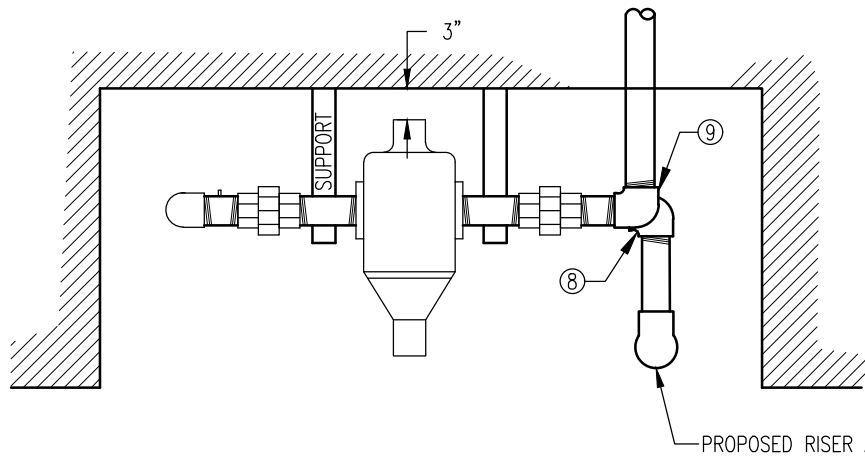
ROOTS METER INSTALLATION

G-12

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

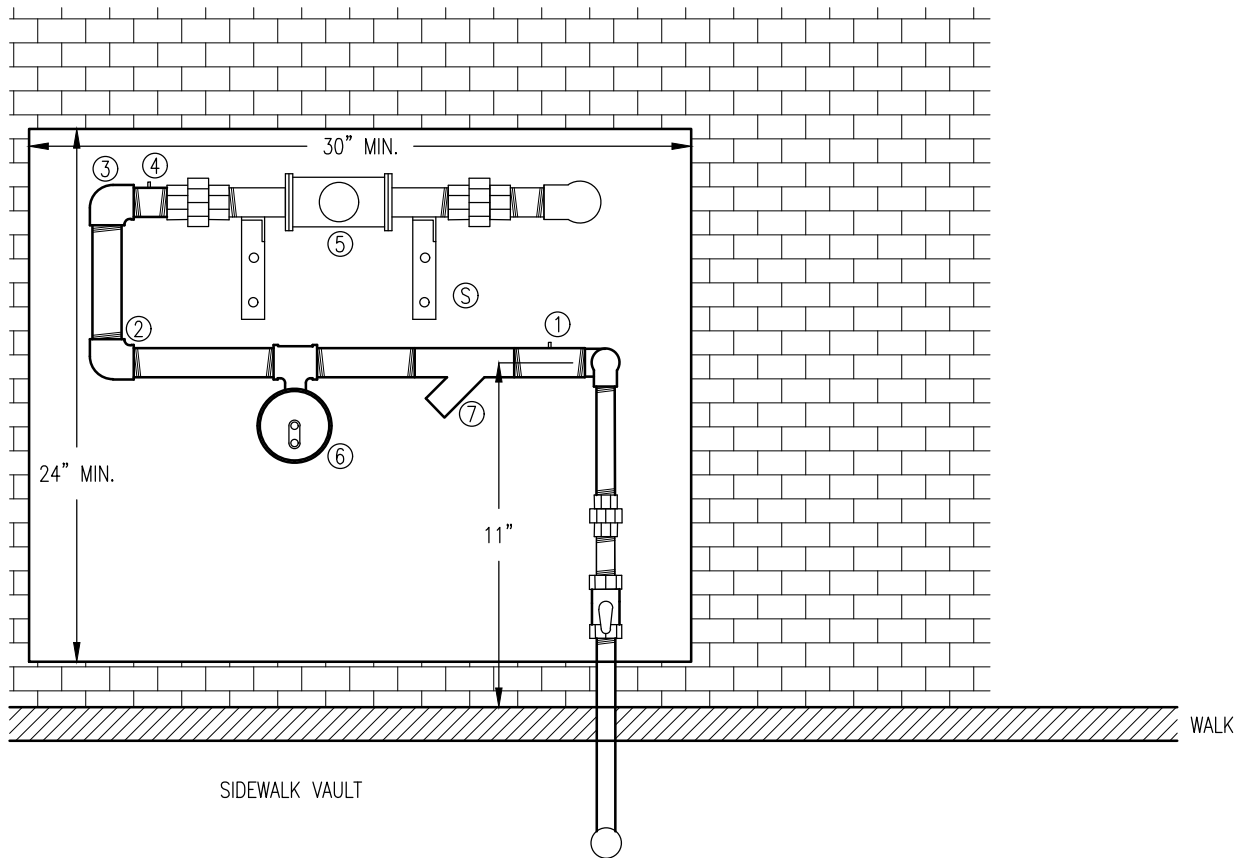
NO SCALE



MATERIALS LIST

1. 1-1/4" x 3" NIPPLE W/ TEST PLUG
2. 1-1/4" x 1/1/2" RED. EL.
3. 1-1/2" EL.
4. 1-1/2" x 3" NIPPLE W/ TEST PLUG
5. 15C ROOTS METER
6. B-31-R WITH 3/16" ORF. REG.
7. 1-1/4" STRAINER
8. 3/4" x 1-1/4" RED. EL.
9. 1-1/2" EL.
- S. ANGLE IRON SUPPORTS

TOP VIEW



FRONT VIEW

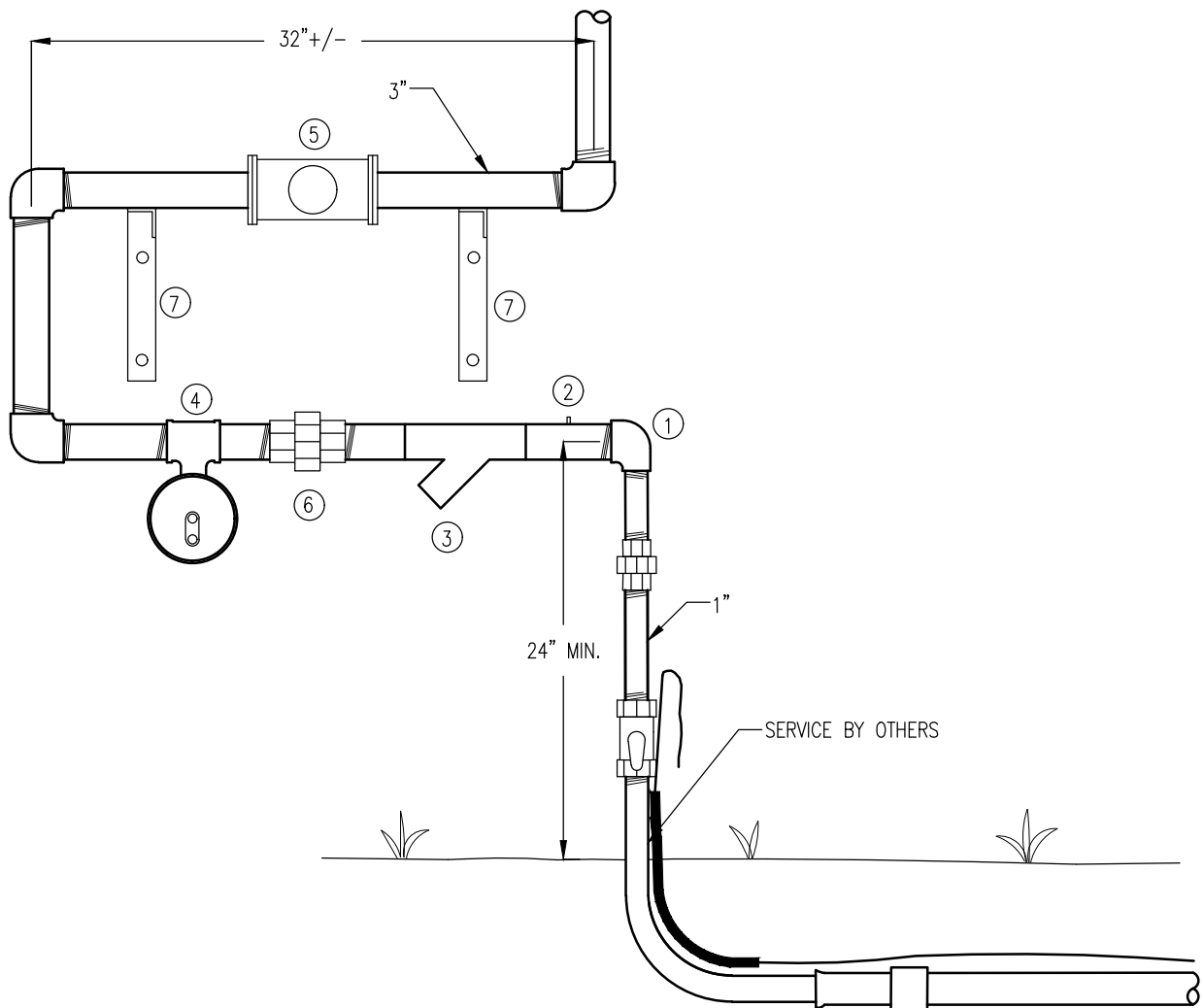
15C ROOTS COMPACT METER INSTALLATION

G-12A

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



MATERIALS LIST

1. 1" x 2" STREET EL
 2. TEST POINTS (D)
 3. 2" STRAINER (D)
 4. FISHER S202 - 2" - W/ 3/8" ORIFICE REGULATOR (D)
 5. 5M ROOTS METER - 3" FLANGE CONNECTION (D)
 6. 2" UNION
 7. ANGLE IRON BRACKETS (D)
- (D) INDICATES TO BE FURNISHED BY DEPARTMENT

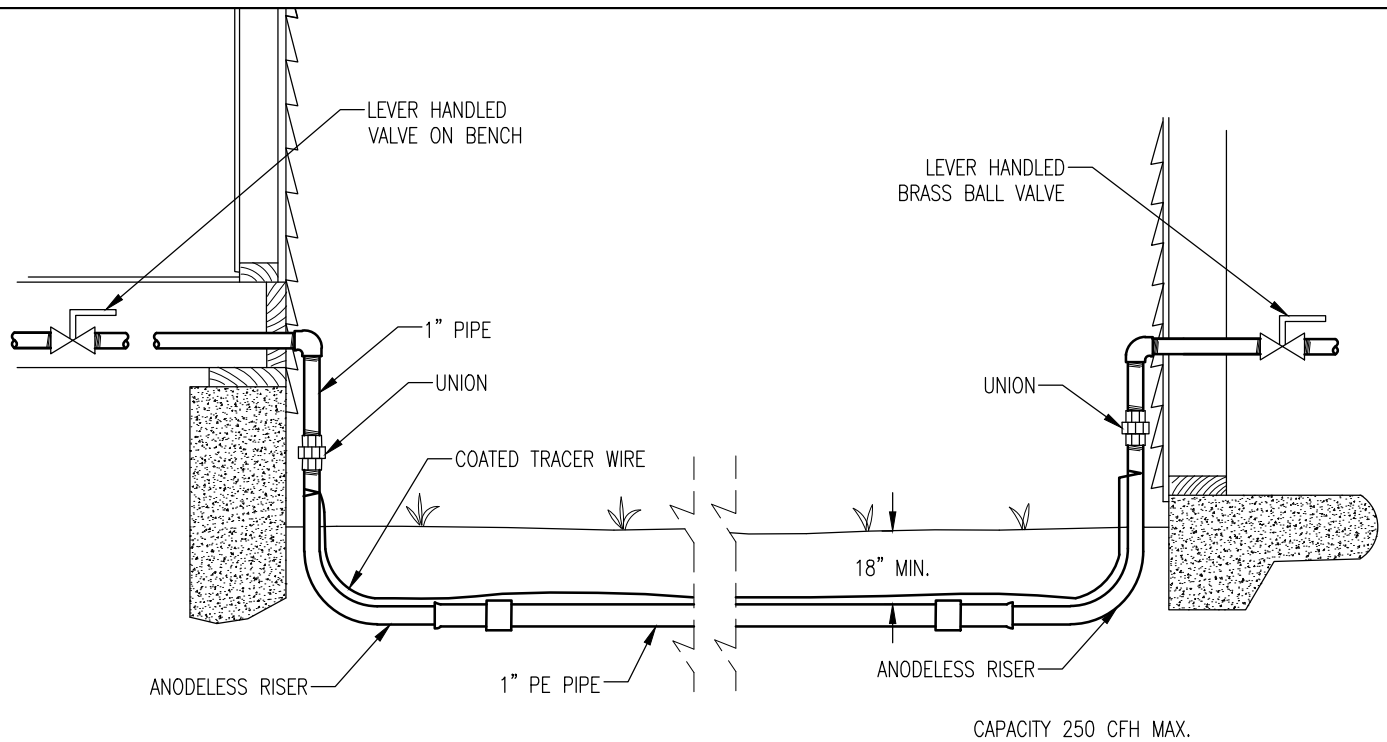
5M ROOTS COMPACT METER INSTALLATION

G-12B

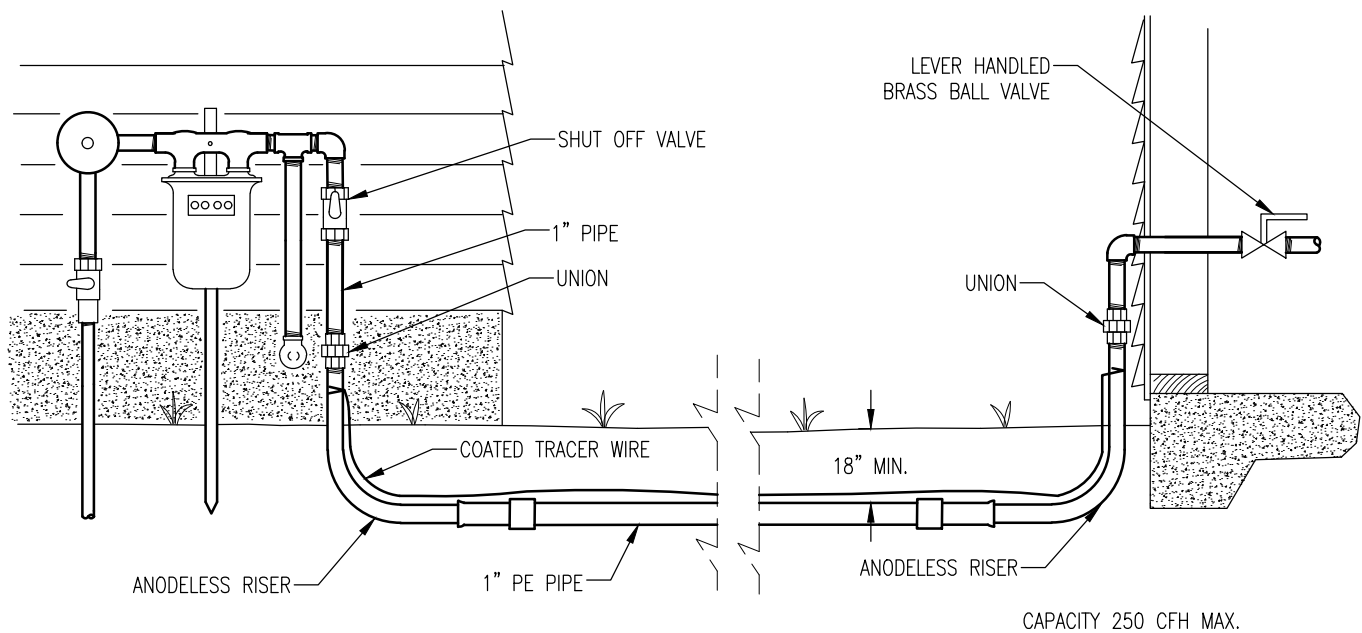
REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



STANDARD TYPICAL GAS FUEL LINE TO OUT BUILDING



STANDARD NON-TYPICAL GAS FUEL LINE TO OUT BUILDING

UNDERGROUND GAS FUEL LINE PIPING – PAST METER

G-13

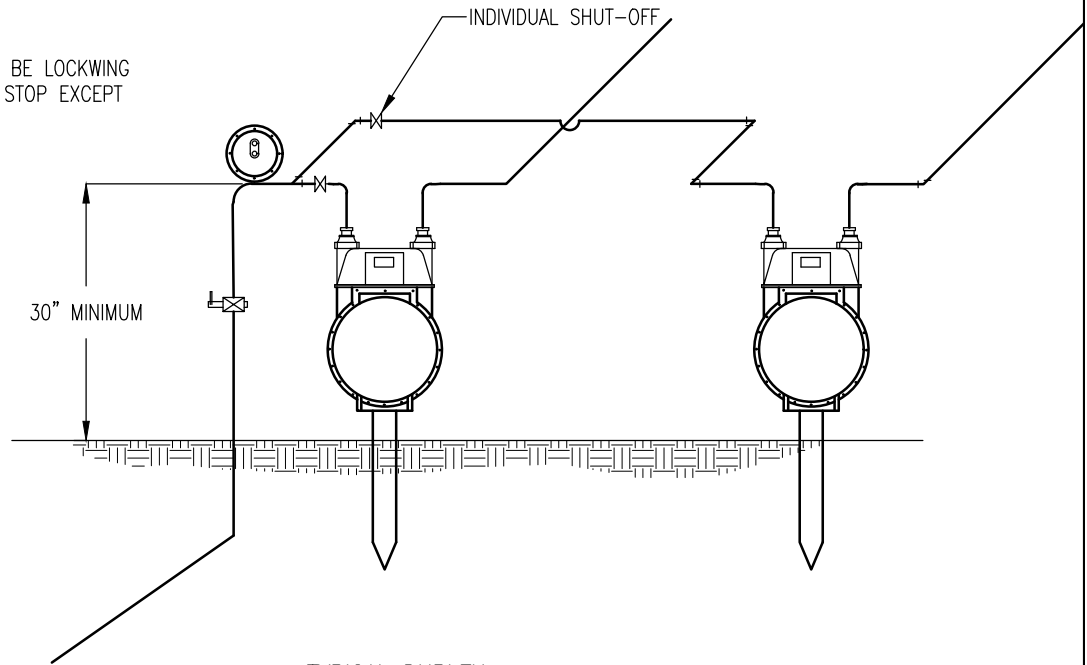
REVISED/APPROVED 07/06/2016

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

SEE SPEC. SECTION 22.03
FOR INSIDE SHUTOFF REQUIRED

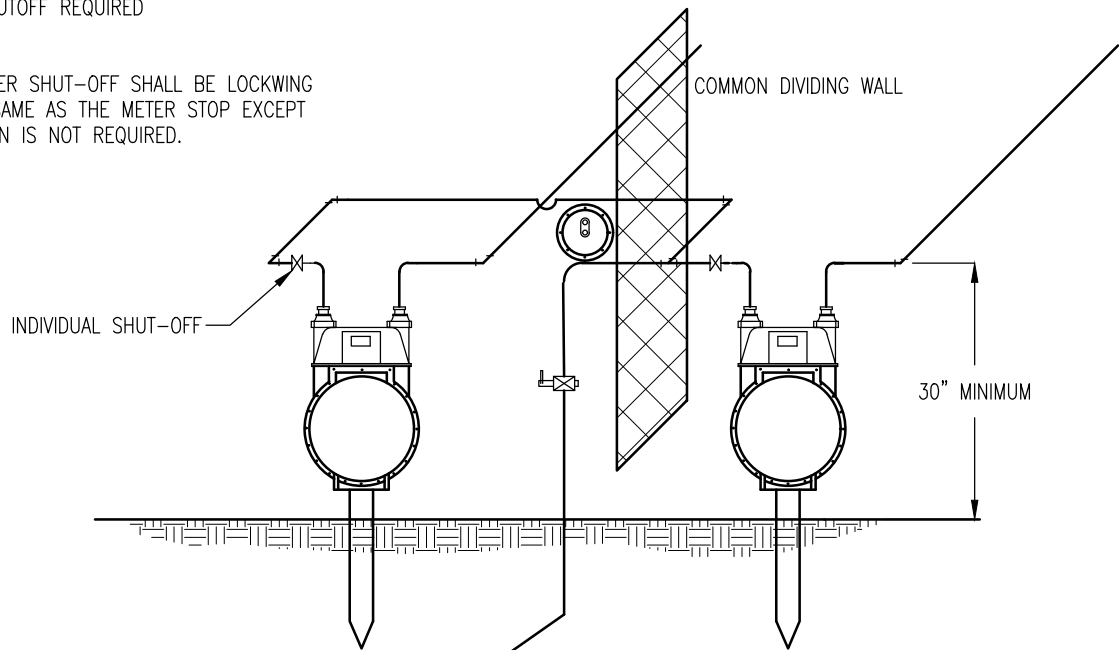
NOTE:
INDIVIDUAL METER SHUT-OFF SHALL BE LOCKWING
STYLE VALVE, SAME AS THE METER STOP EXCEPT
ISOLATING UNION IS NOT REQUIRED.



TYPICAL DUPLEX

SEE SPEC. SECTION 22.03
FOR INSIDE SHUTOFF REQUIRED

NOTE:
INDIVIDUAL METER SHUT-OFF SHALL BE LOCKWING
STYLE VALVE, SAME AS THE METER STOP EXCEPT
ISOLATING UNION IS NOT REQUIRED.



SIDE-BY-SIDE DUPLEX

(IF METERS CAN BE AT DIVIDING WALL)

DUPLEX METER CONNECTION

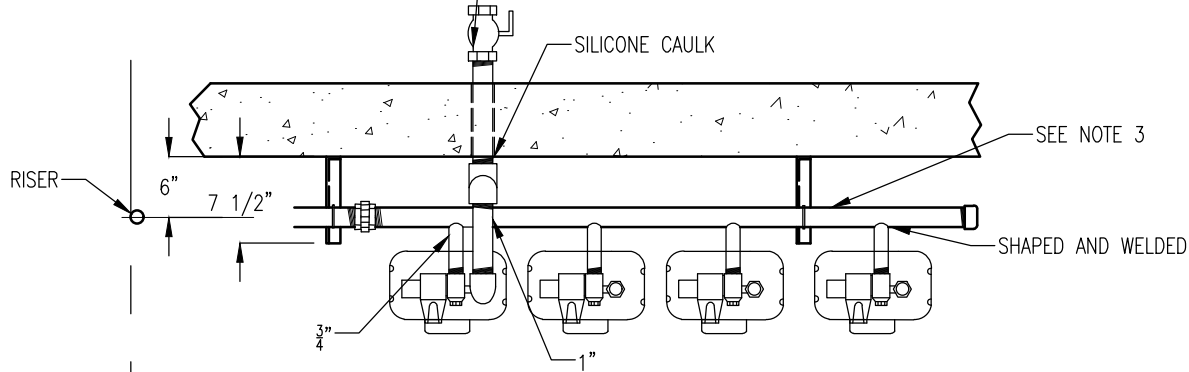
G-14

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

VALVE REQUIRED WHEN SERVING ADJACENT UNIT ONLY. UNITS WHICH ARE REMOTE FROM METER WILL HAVE VALVE CUT IN AT THE UNIT SERVED.

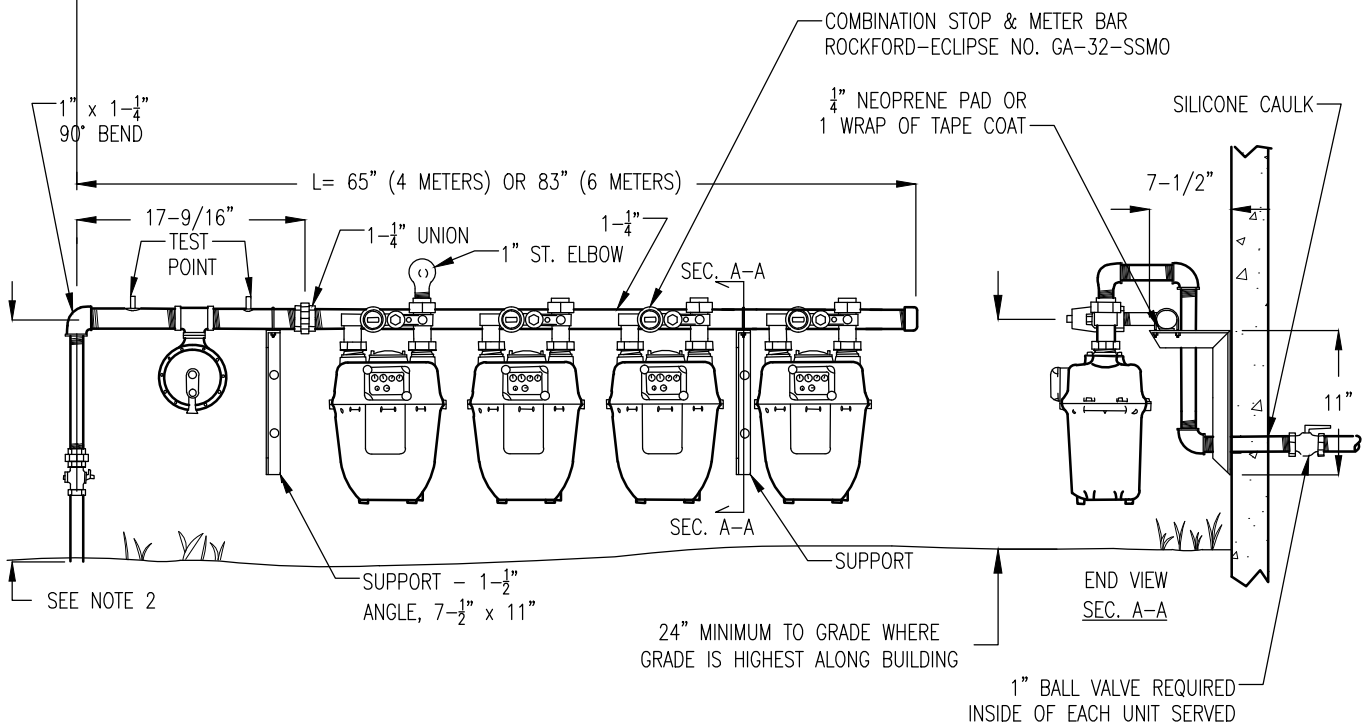


NOTES:

1. 6 METER SET REQUIRES 4 ANGLE SUPPORTS.
2. HEIGHT IS DETERMINED BY ANY METER NOT BEING CLOSER THAN 6" OFF GRADE. MANIFOLD SHALL BE HORIZONTAL.
3. 1-1/4" MANIFOLD BY DEPARTMENT OR MANUFACTURER.
4. DEPARTMENT TO ATTACH BRASS TAG WITH NUMBER OF UNITS SERVICED TO EACH METER BAR.

TOP VIEW

3 OR MORE RESIDENTIAL METERS



FRONT VIEW

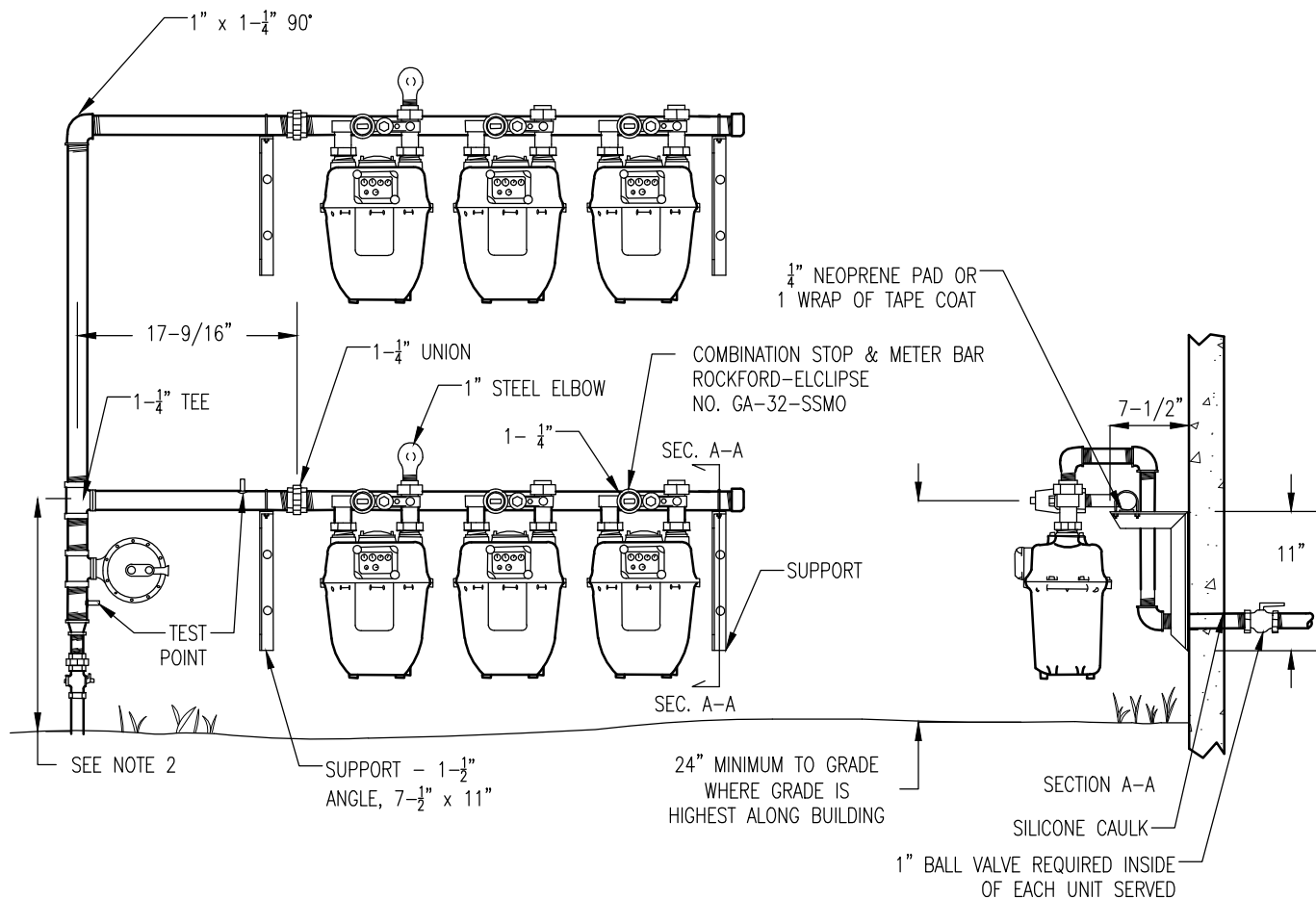
TYPICAL MULTI-METER INSTALLATION

G-14A

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



FRONT VIEW

END VIEW

NOTES

1. 6 METER SET REQUIRES 4 ANGLE SUPPORTS
2. HEIGHT IS DETERMINED BY ANY METER NOT BEING CLOSER THAN 6" OFF GRADE. MANIFOLD SHALL BE HORIZONTAL.
3. 1-1/4" MANIFOLD BY DEPARTMENT OR MANUFACTURER.
4. DEPARTMENT TO ATTACH BRASS TAG W/NUMBER OF UNIT SERVICED TO EACH METER BAR.

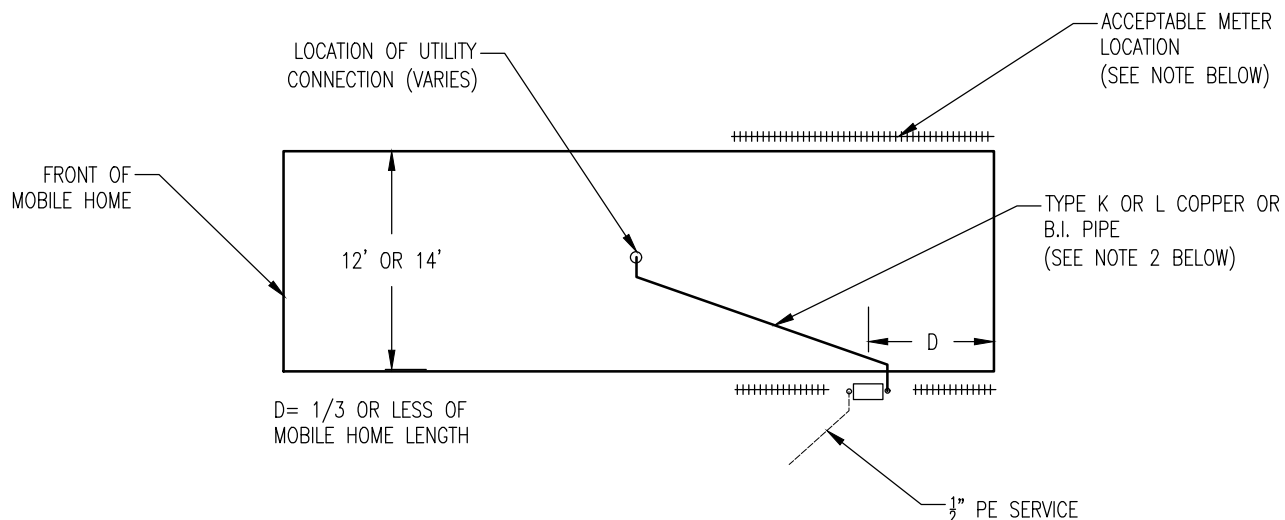
TYPICAL MULTI-METER INSTALLATION – 6 RESIDENTIAL METERS

G-14B

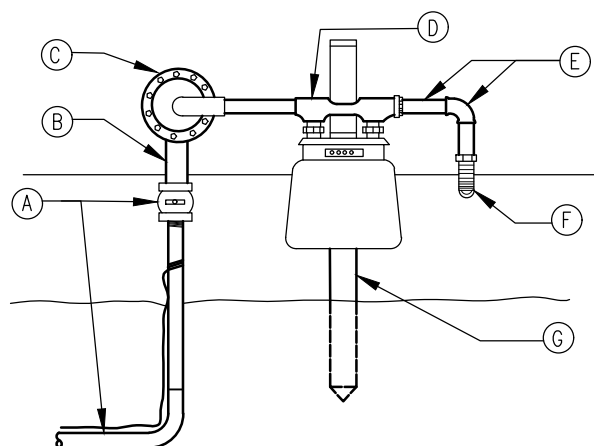
REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

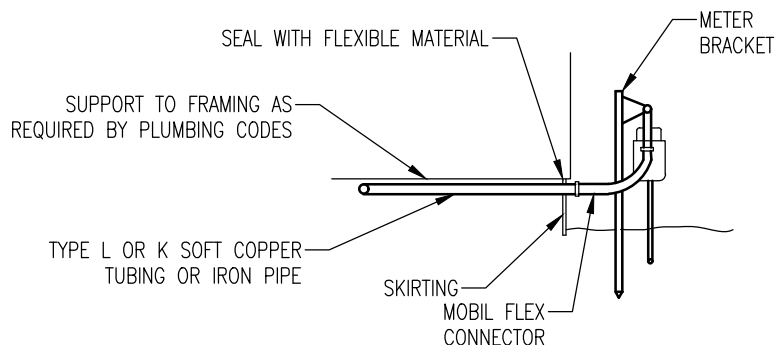
NO SCALE



MOBILE HOME UTILITY CONNECTION



METER SET – FRONT VIEW N.T.S.



MOBILE HOME ENTRANCE – SIDE VIEW N.T.S.

- A. RISER & METER STOP (TO BE INSTALLED BY OTHERS)
- B. 3/4" NIPPLE
- C. REGULATOR – 252 (TO BE FURNISHED BY DEPARTMENT)
- D. METER BAR (TO BE FURNISHED BY DEPARTMENT)
- E. 1" NIPPLE W/ 1" X 3/4" REDUCING ELBOW
- F. MOBILE FLEX CONNECTOR
- G. METER BRACKET (TO BE FURNISHED BY DEPARTMENT)

SPECIFICATIONS:

1. METER LOCATION SHALL BE ALONG THE SIDE AND WITHIN THE REAR 1/3 OF THE TRAILER.
2. ALL HEATING ACCOUNTS TO HAVE NOT LESS THAN 3/4" COPPER LINE WITH FLARED FITTINGS OR 3/4" B.I. PIPE THREADED FROM METER TO POINT WHERE EXISTING LINE ENTERS FLOOR FROM UNDERNEATH. NON-HEATING ACCOUNTS TO HAVE NOT LESS THAN 5/8" COPPER OR 1/2" B.I. PIPE BETWEEN ABOVE MENTIONED POINTS.
3. ANY EXISTING PIPING WHICH MEETS THE ABOVE REQUIREMENTS MAY BE UTILIZED IN MAKING THE CONNECTION.
4. EXISTING AND NEW PIPING DOWNSTREAM FROM FLEXIBLE CONNECTOR SHALL BE PRESSURE TESTED AT 10 PSI BEFORE SETTING METER.

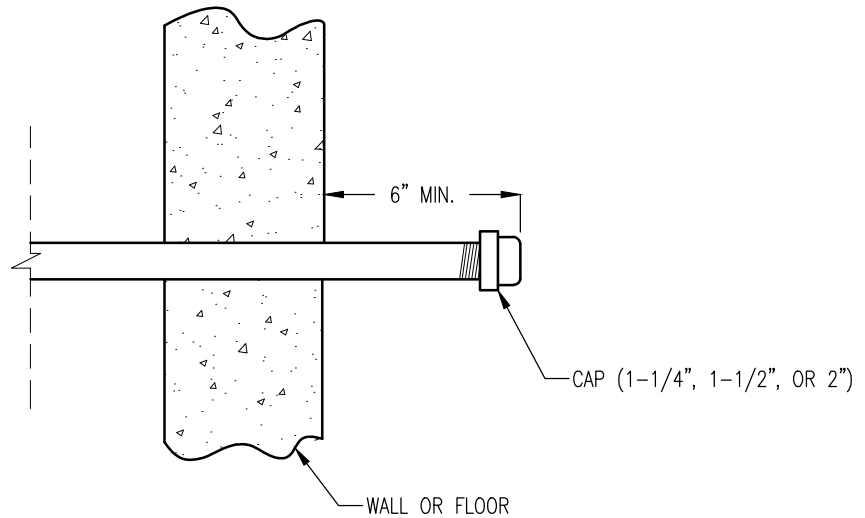
MOBILE HOME GAS METER CONNECTION

G-15

REVISED/APPROVED 02/01/2013

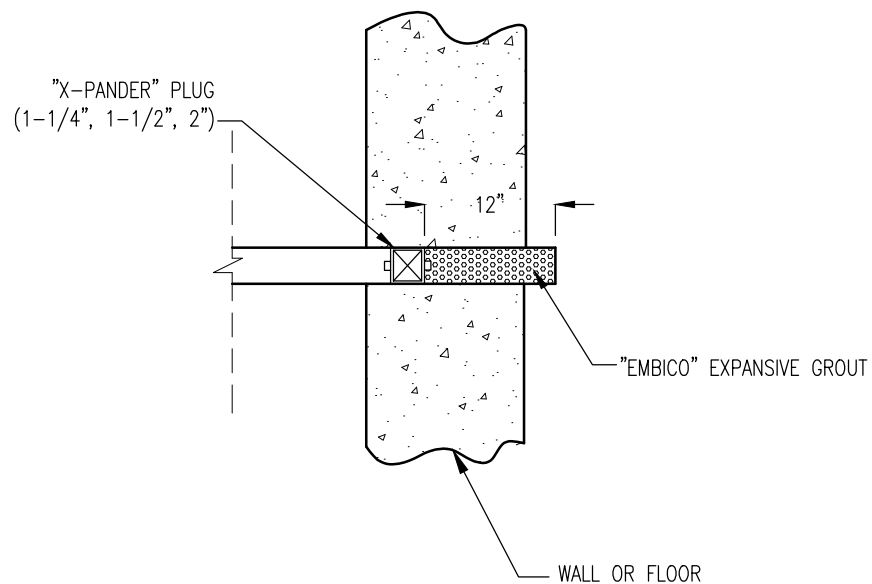
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTE: CAP TO BE INSTALLED AT LAST EXISTING
THREAD NEAREST WALL OR FLOOR EXCEPT WHEN
REQUESTED SHORTER BY OWNER.

STANDARD METHOD



NOTES:

1. DEPARTMENT WILL CUT PIPE OFF CLOSE AS POSSIBLE AND INSTALL EXPANDING RUBBER PLUG AND EXPANSIVE GROUT ONLY UPON SPECIFIC REQUEST BY OWNER. (DEPT POLICY)
2. STREET MAIN MUST BE INACTIVE

SPECIAL METHOD

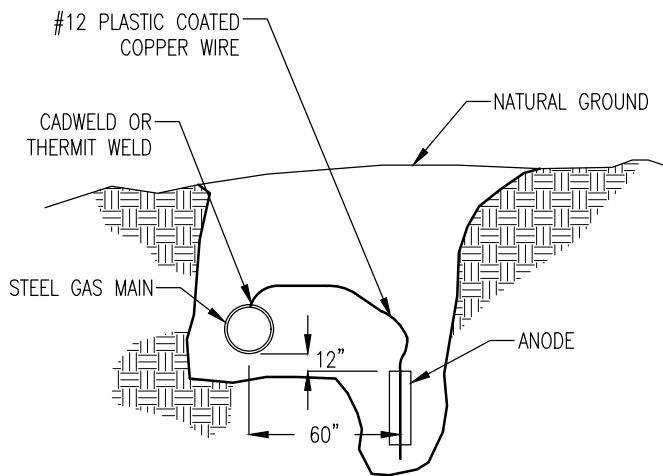
SEALING UNUSED LP GAS SERVICES

G-16

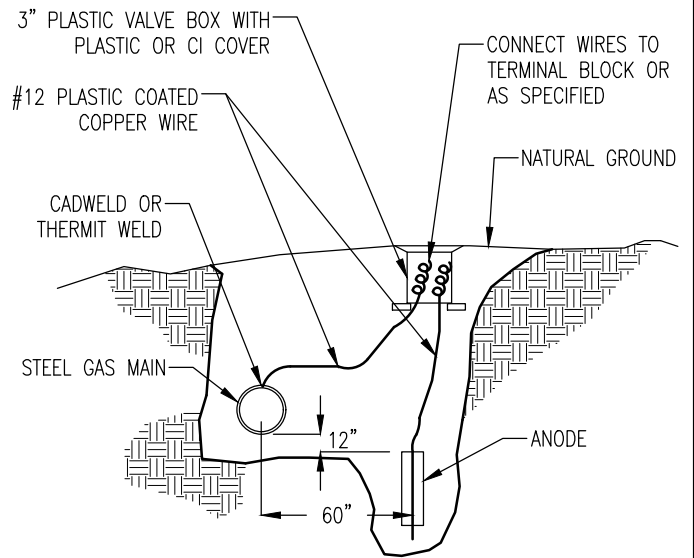
REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

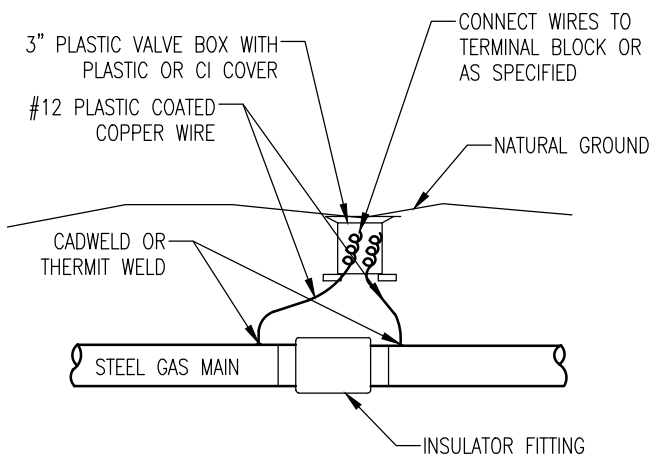
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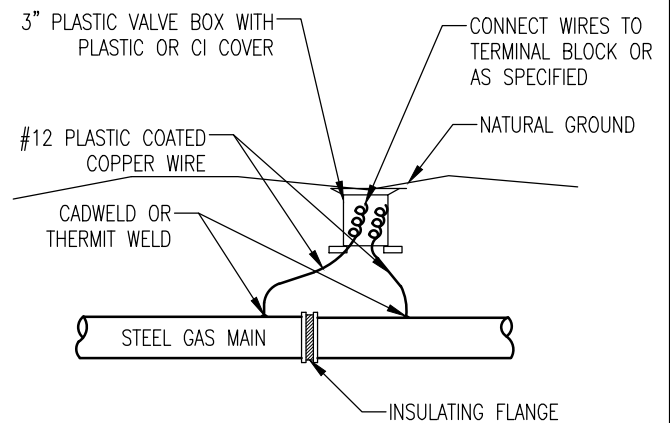
ANODE WITHOUT TEST LEADS



ANODE WITH TEST LEADS



TYPICAL INSULATOR WITH TEST LEADS



TYPICAL INSULATING FLANGE WITH TEST LEADS

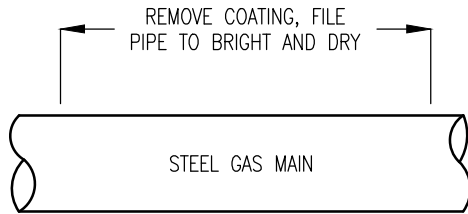
CATHODIC PROTECTION

G-17

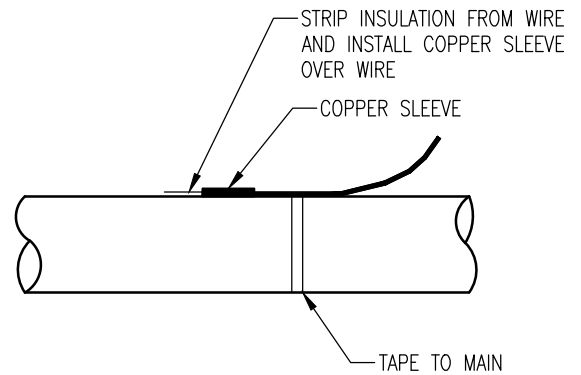
REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



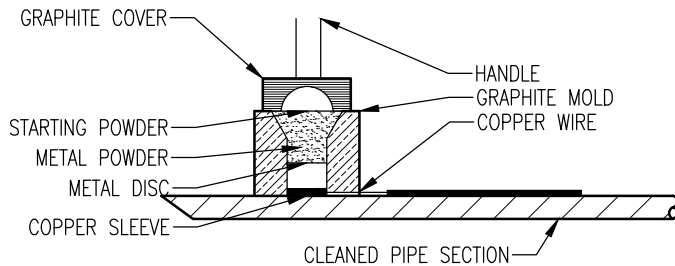
STEP 1



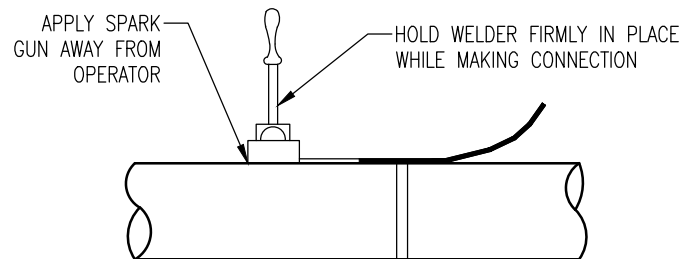
STEP 2

PROCEDURES

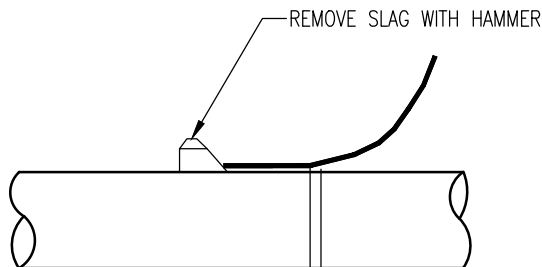
1. PREPARE GRAPHITE MOLD AS SHOWN IN DETAIL.
 - A. PLACE METAL DISC
 - B. PLACE METAL POWER
 - C. FILL WITH STARTING POWDER
 - D. PLACE GRAPHITE COVER
 2. PLACE GRAPHITE MOLD ON PIPE
- MAXIMUM SIZE CHARGE TO
BE USED SHALL BE
"CADWELD" CA-15.



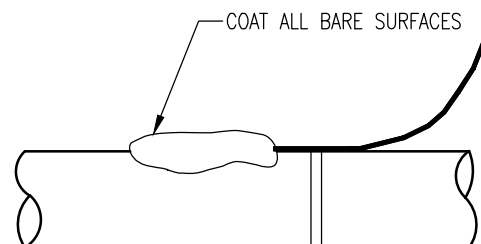
STEP 3



STEP 4



STEP 5



STEP 6

TYPICAL METHOD OF BRAZED CONNECTION TO PIPE

G-18

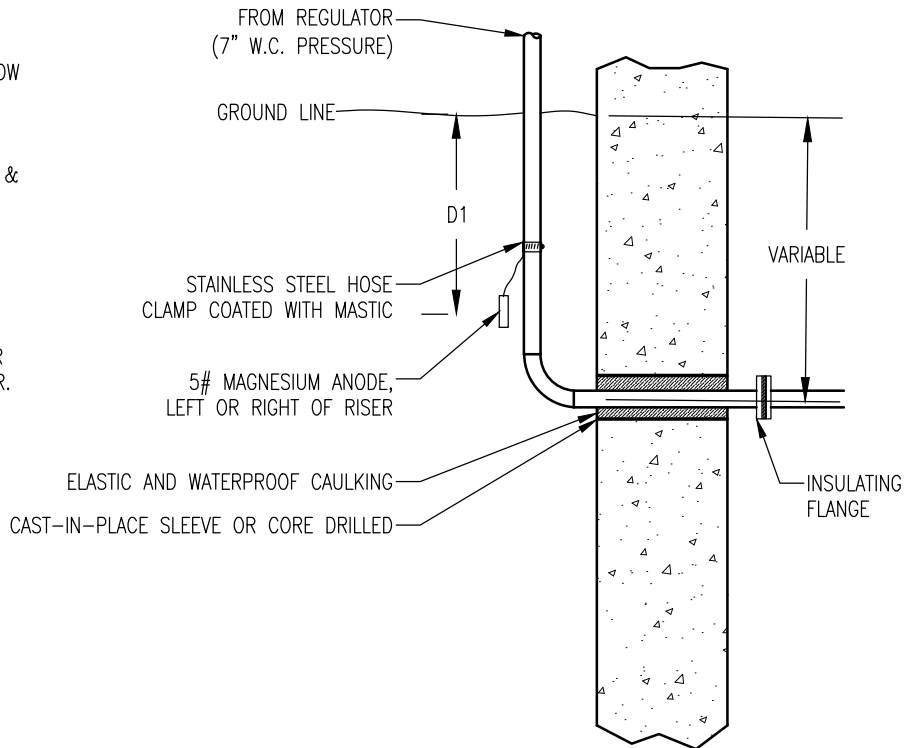
REVISED/APPROVED 02/01/213

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

NOTES:

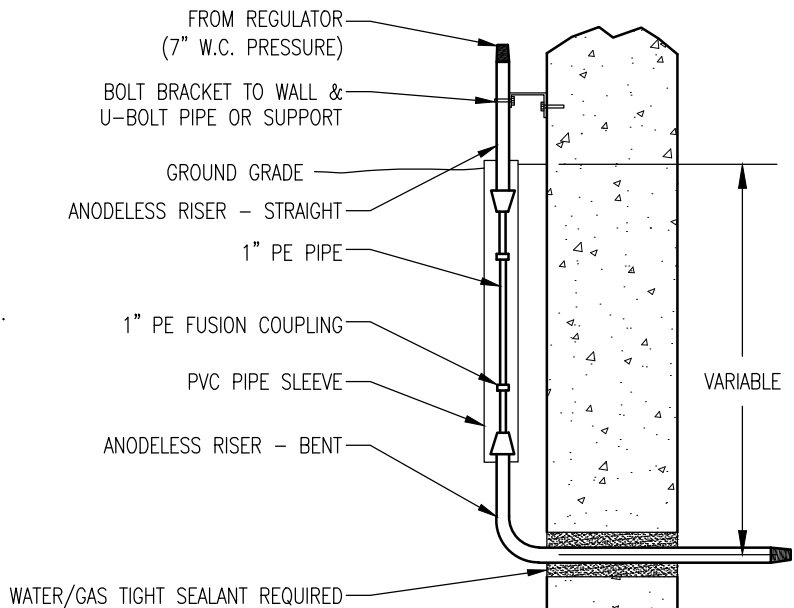
1. ABOVE GRADE ENTRY IS REQUIRED GENERALLY, BELOW GRADE WILL BE PERMITTED ONLY BY SPECIAL EXCEPTION.
2. PIPE SHALL BE AT LEAST STANDARD WEIGHT STEEL, CONFORMING TO A53 OR API 5L, WELDED, COATED, & WRAPPED ACCORDING TO STANDARD SPECIFICATION SECTION 25.
3. GAS PIPE THROUGH WALL SHALL BE IN SLEEVE OR CORE DRILLED HOLE AND ANNULAR SPACE SEALED WITH ELASTIC & WATERPROOF CAULKING. CEMENT CAULK NOT PERMITTED.
4. ANODE DEPTH (D1) SHALL BE A MINIMUM OF 2' OR BELOW MID DEPTH OF RISER, WHICHEVER IS DEEPER.



BELOW GRADE GAS PIPE ENTRY – 2 1/2" & LARGER

NOTES

1. ABOVE GRADE ENTRY IS REQUIRED GENERALLY, BELOW GRADE WILL BE PERMITTED ONLY BY SPECIAL EXCEPTION.
2. PE COUPLING SHALL BE FUSED ONLY BY CERTIFIED FUSORS – STANDARD SPECIFICATION SEC. 17.



BELOW GRADE GAS PIPE ENTRY – 1" & 2"

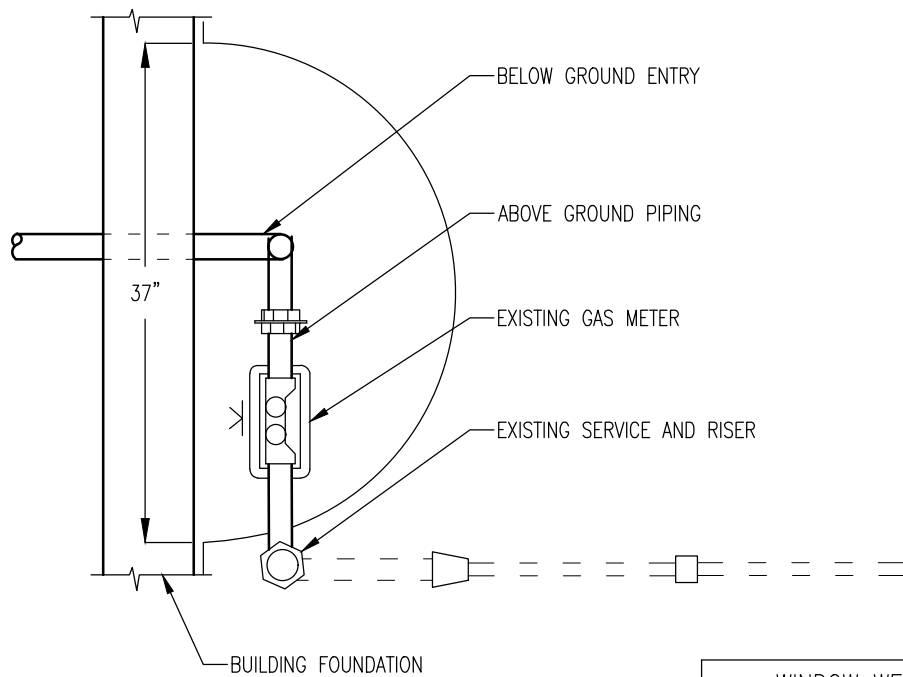
GAS PIPING BUILDING ENTRY BELOW GRADE

G-22

REVISED/APPROVED 01/08/216

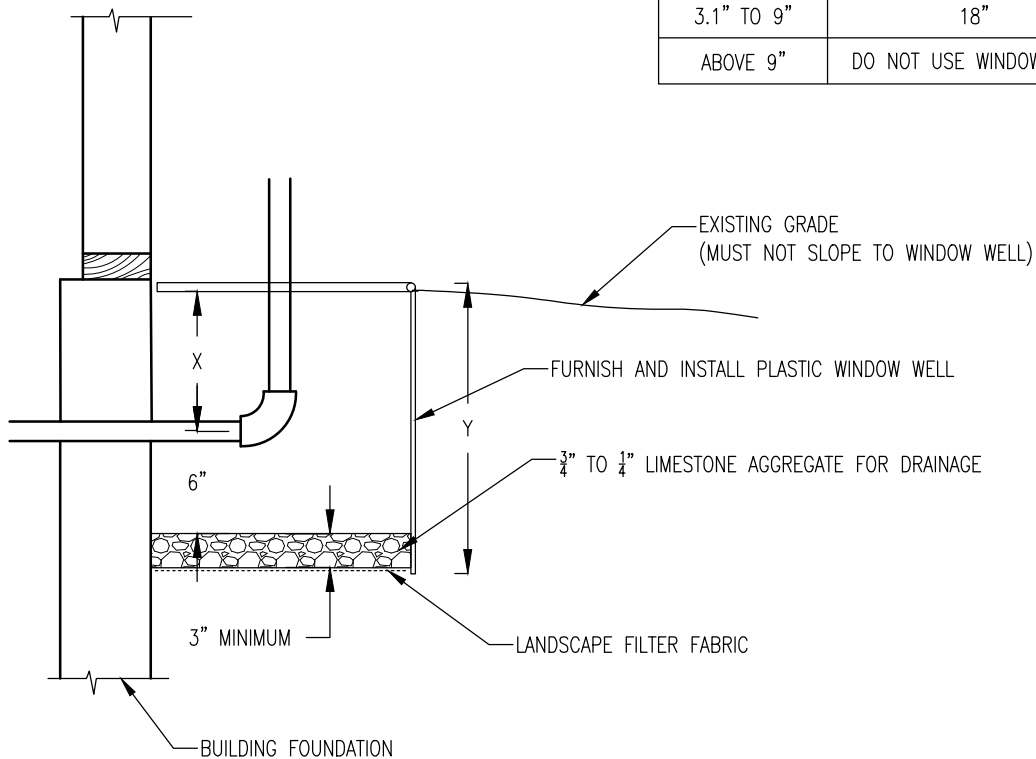
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



PLAN VIEW

WINDOW WELL SIZING CHART	
IF X IS...	Y=
3" OR LESS	12"
3.1" TO 9"	18"
ABOVE 9"	DO NOT USE WINDOW WELL



SIDE VIEW

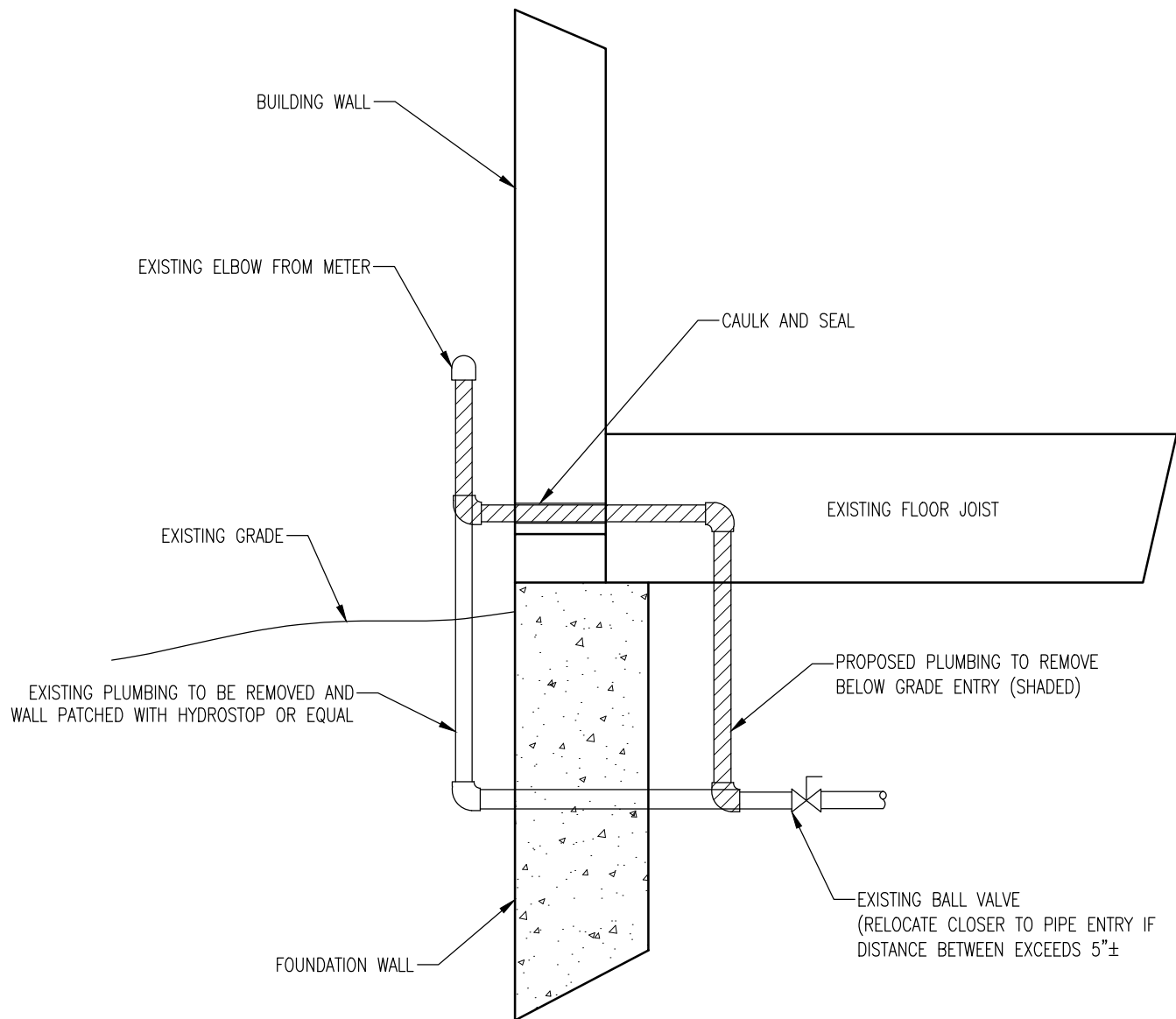
TYPICAL WELL FOR BELOW GRADE GAS PIPE ENTRY

G-23

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



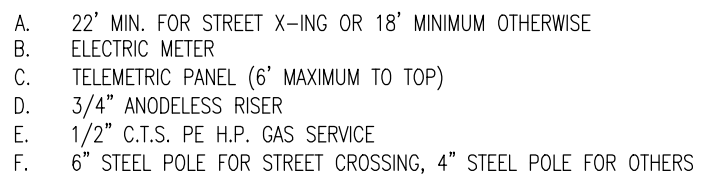
TYPICAL GAS PIPING REVISION

G-24

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

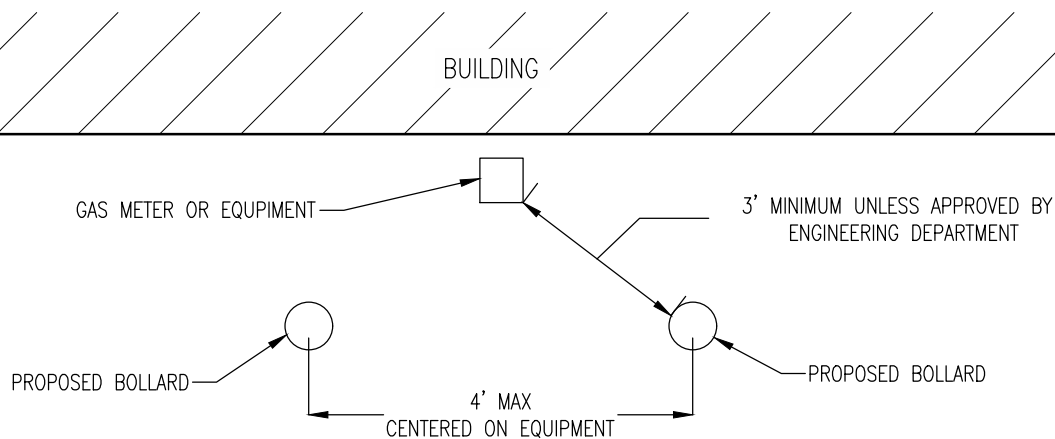
NO SCALE



G-26

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

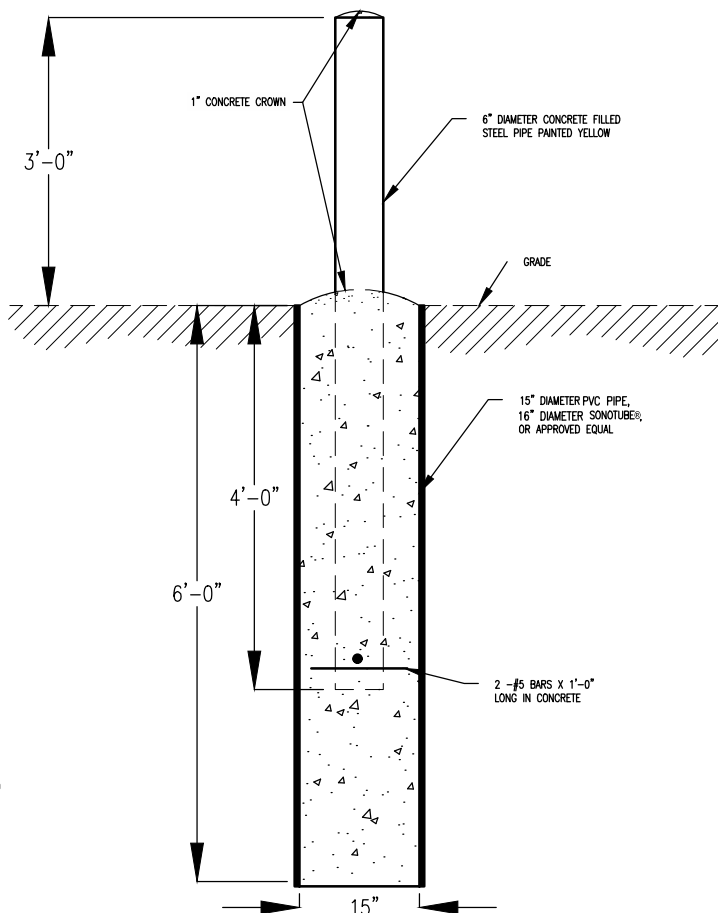


NOTES

1. MULTIPLE BOLLARDS SHALL BE SPACED AT 4' ON CENTER
2. BACKFILL BOLLARD WITH WASTE CUTTINGS, COMPACT TO 95% MAXIMUM DENSITY.
3. BOLLARD SHALL BE FINISHED WITH ONE OF THE FOLLOWING METHODS:
 - A. COVERED WITH A HDPE PLASTIC BOLLARD SLEEVE DESIGNED TO FIT OVER A 6" PIPE BOLLARD. THE SLEEVE SHALL HAVE A SMOOTH FINISH, DOME TOP, AND BE YELLOW IN COLOR. AN ADHESIVE SEALANT SHALL BE USED TO AFFIX THE SLEEVE TO THE BOLLARD.
 - B. PAINTED TO THE FOLLOWING SPECIFICATIONS

SURFACE PREPARATION	BLAST TO THE EXTENT OF AN SSPC-SP6 COMMERCIAL-GRADE LEVEL OF CLEANLINESS AND PRIME BEFORE ANY RUST BLOOM REFORMS
PRIMER	APPLY ONE EVEN COAT OF TNEDEC SERIES 69-COLOR PRIMER TO A DFT OF 5.0 MILS
FIELD FINISH	APPLY ONE EVEN COAT OF TNEDEC SERIES 69-COLOR TO A DFT OF 5.0 MILS
FINAL FINISH	APPLY ONE COAT TNEDEC SERIES 73-COLOR TO A DFT OF 2.0-2.5 MILS OVER THE FIELD FINISH
COLORS	BOLLARDS: SAFETY YELLOW

- C. COVERED WITH A HDPE PLASTIC BOLLARD SLEEVE DESIGNED TO FIT OVER A 6" PIPE BOLLARD. THE SLEEVE SHALL HAVE A SMOOTH FINISH, DOME TOP, AND BE YELLOW IN COLOR. AN ADHESIVE SEALANT SHALL BE USED TO AFFIX THE SLEEVE TO THE BOLLARD.



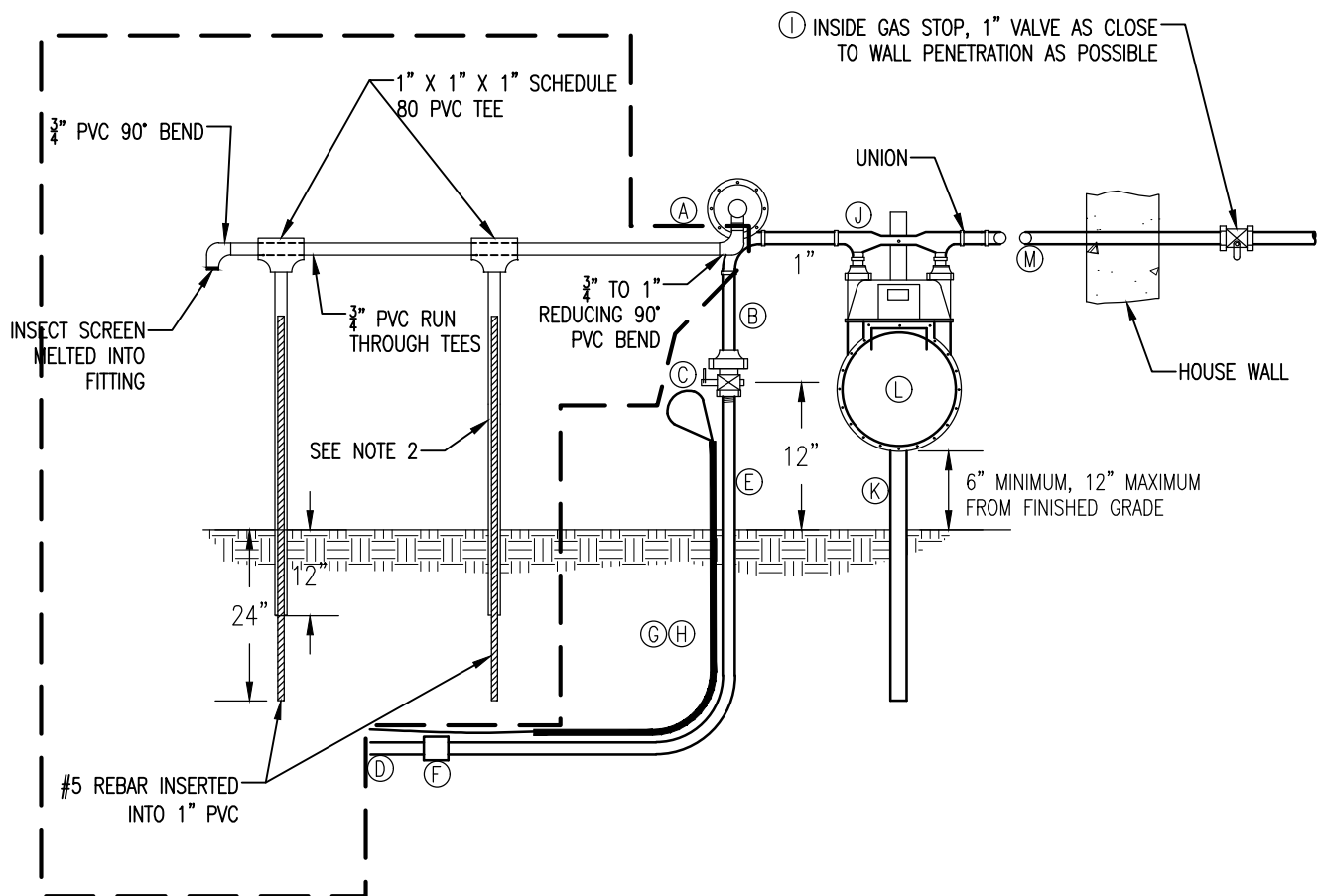
BOLLARD DETAIL

G-33

REVISED/APPROVED 02/19/2015

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



- A. REGULATOR, SCHUMBERGER B-42 WITH 1/8" ORIFICE
- B. 3/4" NIPPLE
- C. 3/4" METER STOP
- D. PE SERVICE
- E. 1/2" X 3/4" ANODELESS SERVICE RISER
- F. 1/2" C.T.S. PE SOCKET COUPLING
- G. 1/2" P.E. TO PROTECT TRACER WIRE
- H. COATED TRACER WIRE
- I. 1" BRONZE BALL VALVE
- J. ROCKFORD ECLIPSE 701173 26-M WEDGESEAL METER BAR (OR EQUAL)
- K. ADVANCE ENG. CORP. D.P. 1004 METER MOUNTING BRACKET (OR EQUAL)
- L. METER
- M. 1" MINIMUM BLACK STEEL PIPE

NOTES:

1. VENT MAY DISCHARGE FROM REGULATOR TO THE LEFT (SHOWN) OR RIGHT, IF RIGHT ADDITIONAL FITTINGS MAY BE REQUIRED.
2. VENT EXTENSIONS LESS THAN 5' ONLY REQUIRE ONE GROUND SUPPORT POST. MULTIPLE POSTS SHALL BE NO MORE THAN 4' APART.
3. PIPE SHALL BE INSTALLED WITH NEGATIVE SLOPE FROM THE REGULATOR TO THE DISCHARGE.
4. ALL PVC VENT PIPE AND FITTINGS SHALL BE GRAY. PIPE MATERIALS SHALL BE SCHEDULE 80 AND FITTINGS SHALL BE SCHEDULE 40.

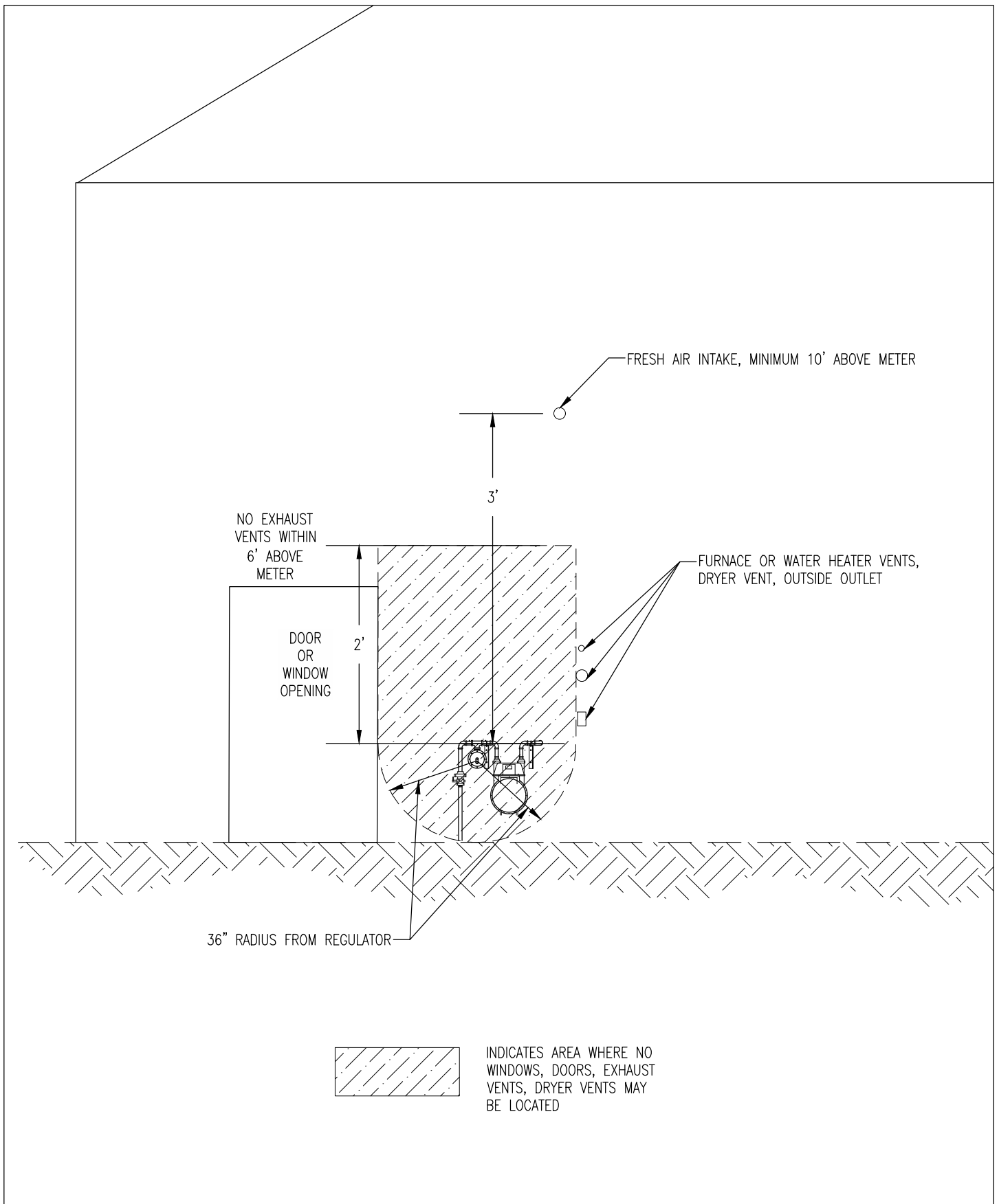
REGULATOR VENT EXTENSION

G-34

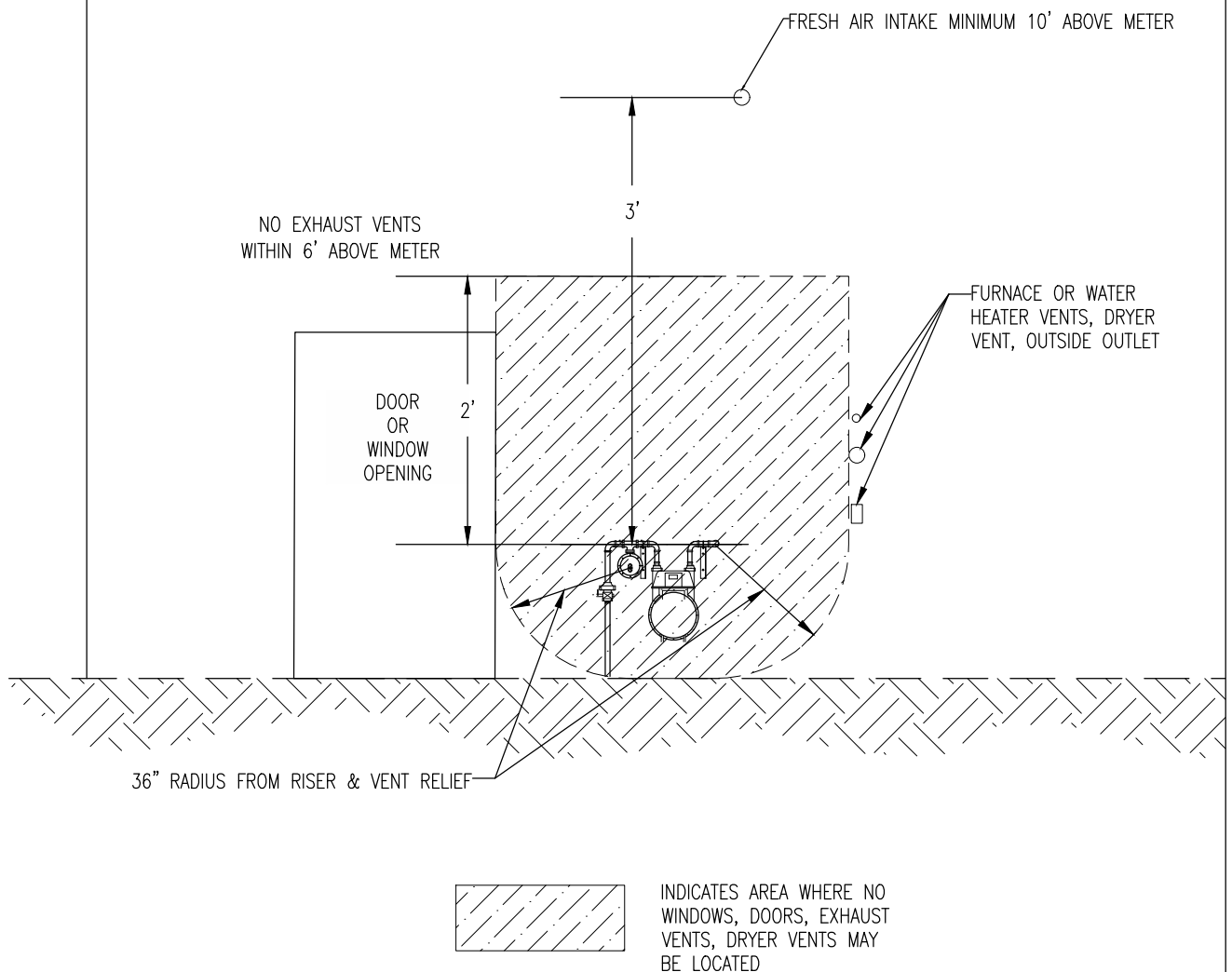
REVISED/APPROVED 06/01/2014

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



7" WC METERING PRESSURE METER LOCATION		G-35
REVISED/APPROVED 06/01/2014	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



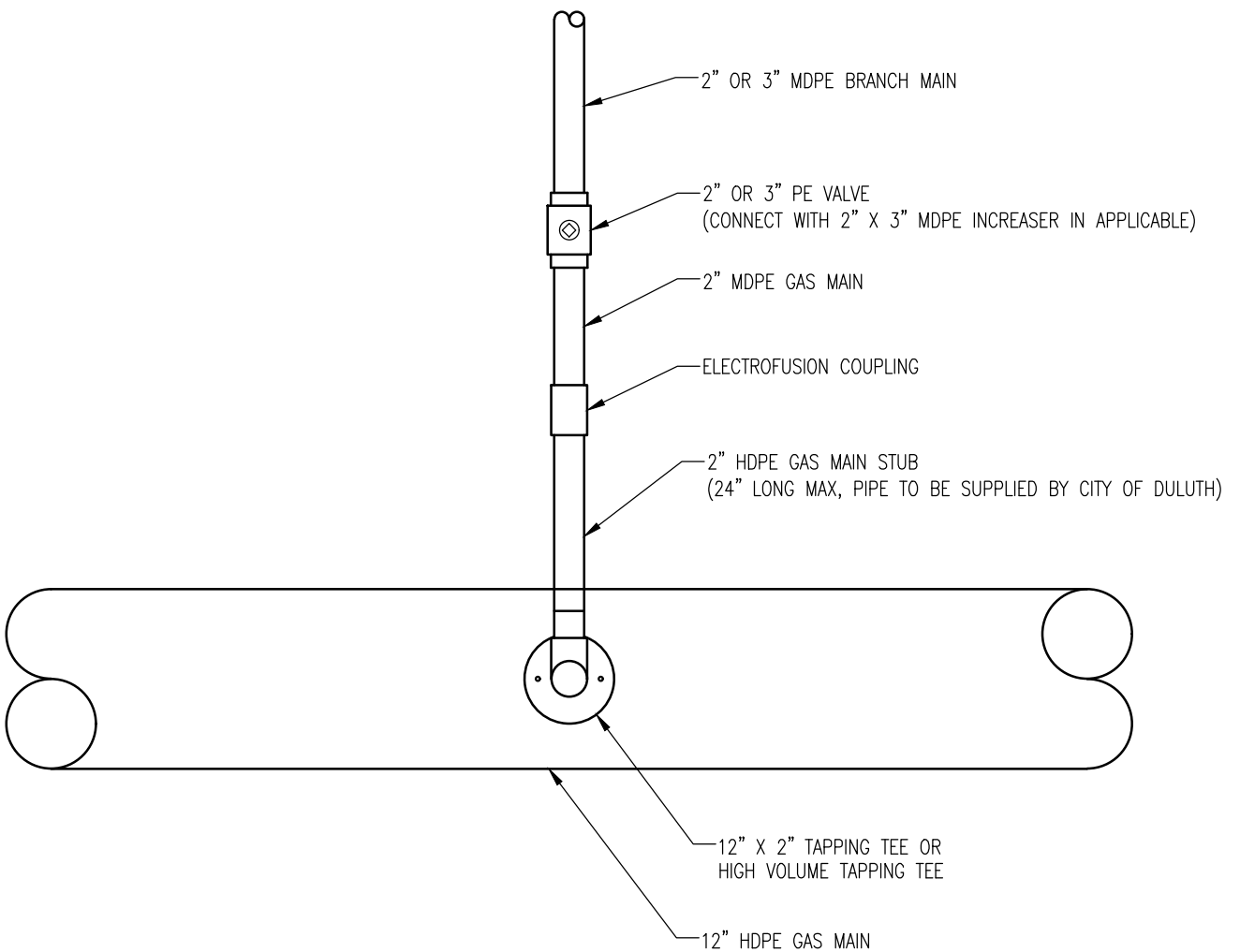
ELEVATED PRESSURE METER LOCATION

G-36

REVISED/APPROVED 06/01/2014

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



2" OR 3" BRANCH MAIN CONNECTION DETAIL FOR HDPE GAS MAINS

G-37

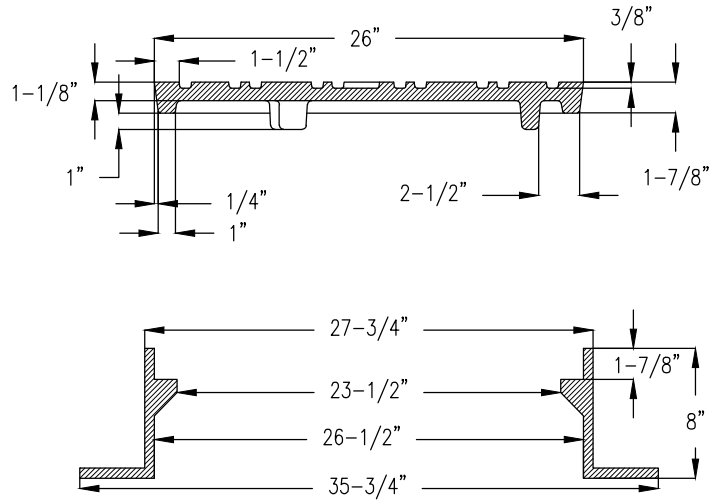
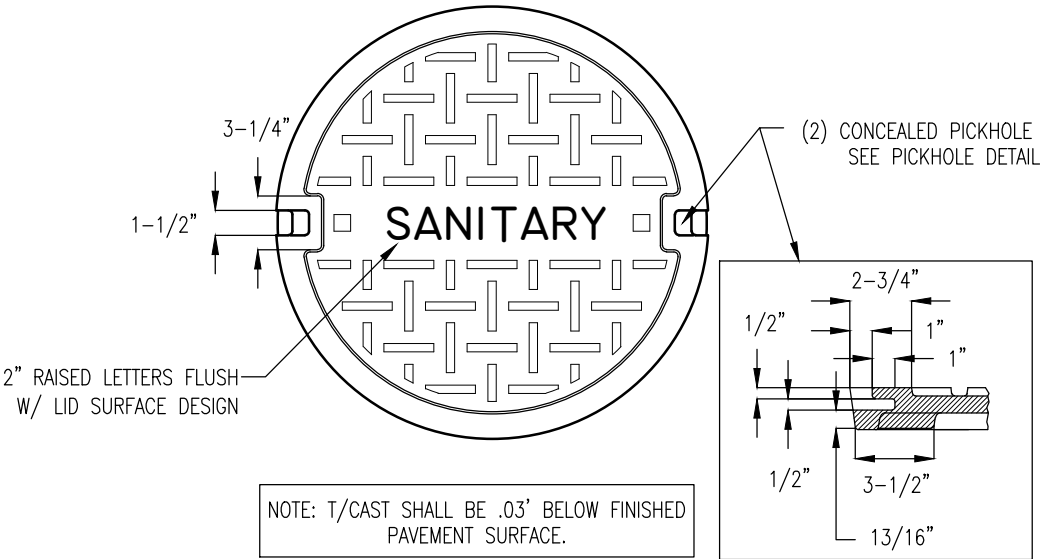
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

WGT. 298 LBS		MATERIAL: GRAY IRON CLASS 35B
WGT. 122 LBS	TOTAL WEIGHT 420 LBS.	SPEC.: ASTM A-48-74

NOTE: SUITABLE FOR HS25 WHEEL LOADS



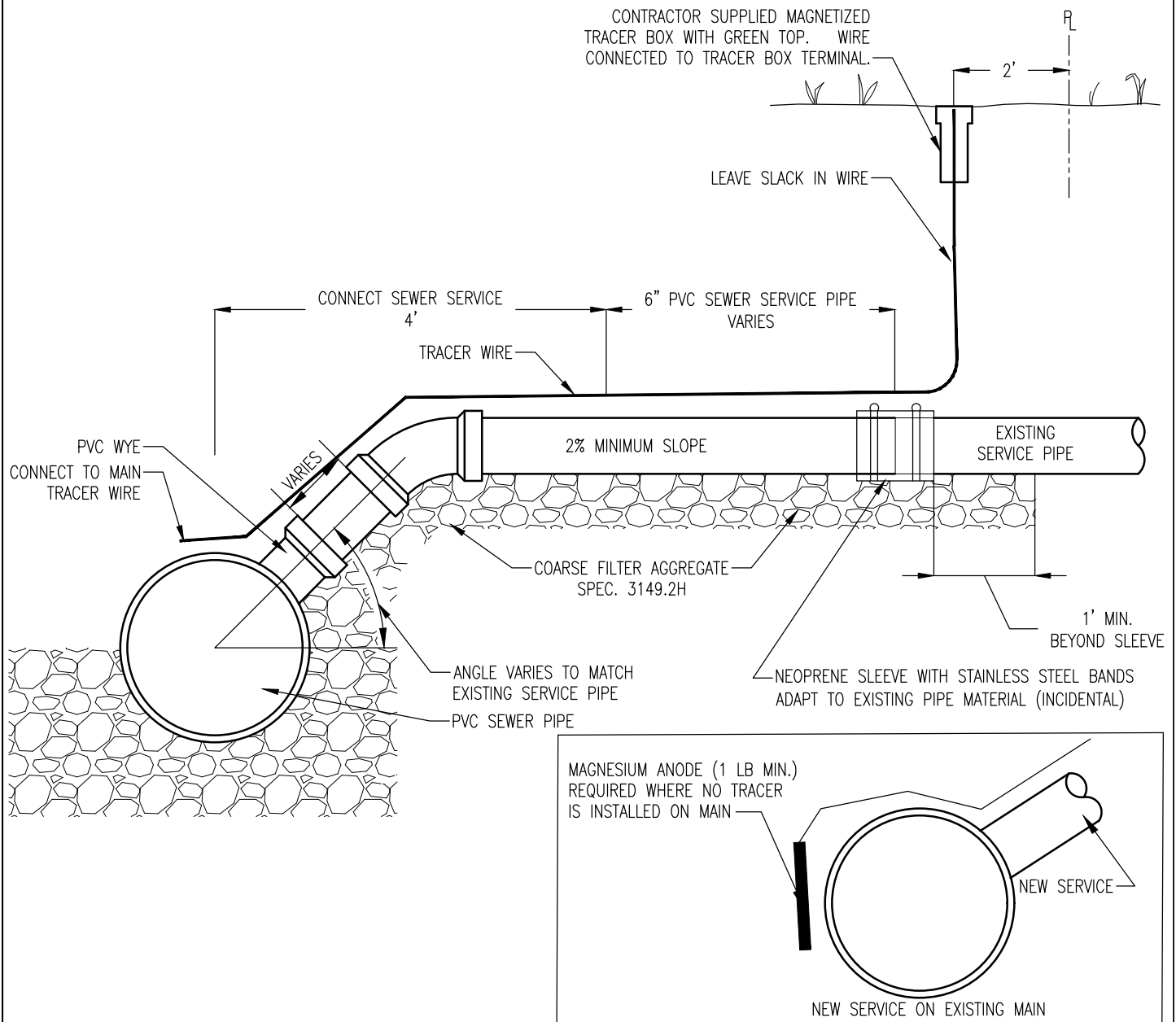
SANITARY CASTING DETAIL

SAN-1

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES

1. BID ITEM FOR PVC WYE INCLUDES FURNISHING AND INSTALLING WYE IN SEWER MAIN.
2. CONNECT SEWER SERVICE INCLUDES 6" PVC SEWER SERVICE PIPE (TO 4' FROM C/L) AND ALL FITTINGS
3. 6" PVC SEWER SERVICE PIPE IS INTENDED FOR THE RECONSTRUCTION OF SEWER SERVICES (WHEN FOUND TO BE IN NEED BY THE ENGINEER) COMPLETE IN PLACE FROM 4.0' BEYOND THE C/L OF THE SEWER MAIN TO A POINT DESIGNATED BY THE ENGINEER
4. FOR NEW SERVICES, PIPE TO STOP AT RIGHT OF WAY
5. #12 GAUGE GREEN INSULATED COPPER TRACER WIRE SHALL BE INSTALLED WITH SANITARY SEWER MAINS AND SERVICES. TRACER WIRE TERMINAL BOXES SHALL BE INSTALLED DIRECTLY ABOVE THE SEWER SERVICE OR AS DETERMINED BY THE ENGINEER
6. FOR SERVICES, TRACER WIRE SHALL RUN FROM THE WYE AND TERMINATE IN A FLUSH MOUNTED TRACER BOX WITH A GREEN CAST IRON LOCKABLE TOP.
7. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

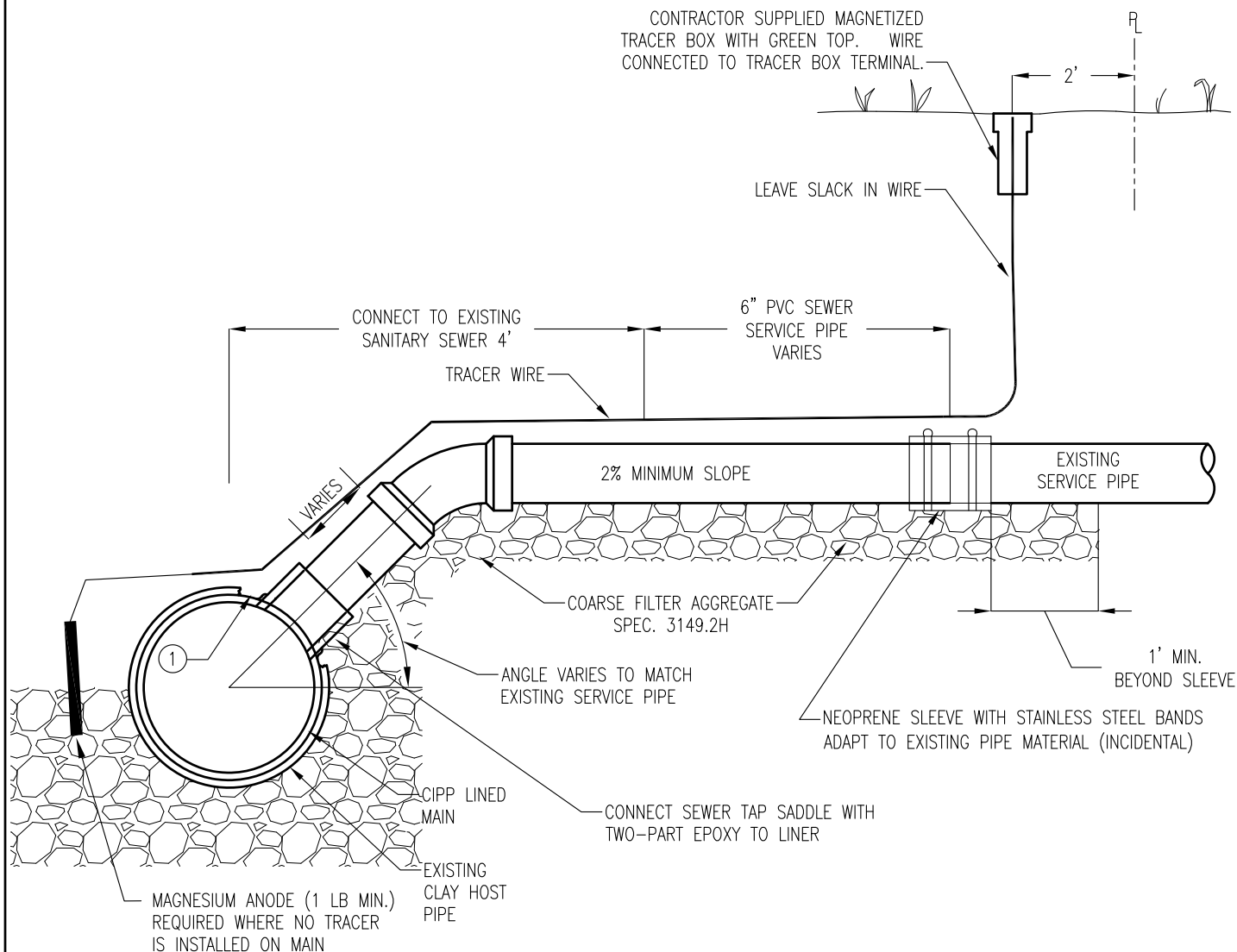
TYPICAL SEWER SERVICE CONNECTION

SAN-2

REVISED/APPROVED 02/19/2015

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES

1. REMOVE PORTION OF EXISTING HOST PIPE TO EXPOSE CIPP LINER. CUT CIRCULAR HOLE IN CIPP LINER. WHERE THE EXISTING OPENING OF THE CIPP LINER EXCEEDS THE SIZE FOR A NEW SEWER TAP SADDLE, CONSTRUCT EPOXY LINER PATCH, AND CUT CIRCULAR HOLE IN CURED PATCH.
2. PROVIDE NEW PVC SEWER TAP SADDLE ON IN-PLACE SEWER MAIN LINER CONNECTED BY TWO-PART EPOXY GLUED JOINT FORMING A WATERTIGHT CONNECTION TO CIPP LINER.
3. CONNECT SEWER SERVICE INCLUDES SEWER TAP SADDLE, 6" PVC SEWER SERVICE PIPE (TO 4' FROM C/L) AND ALL FITTINGS.
4. 6" PVC SEWER SERVICE PIPE INTENDED FOR THE RECONSTRUCTION OF SEWER SERVICES (WHEN FOUND TO BE IN NEED BY THE ENGINEER) COMPLETE IN PLACE FROM 4.0' BEYOND THE C/L OF THE SEWER MAIN TO A POINT DESIGNATED BY THE ENGINEER.
5. FOR NEW SERVICES, PIPE TO STOP AT THE RIGHT OF WAY.
6. #12 GAUGE GREEN INSULATED SOLID COPPER WIRE SHALL BE INSTALLED WITH SANITARY SEWER MAINS AND SERVICES. TRACER WIRE TERMINAL BOXES SHALL BE INSTALLED DIRECTLY ABOVE THE SEWER SERVICE OR AS DIRECTED BY ENGINEER.
7. FOR SERVICES, TRACER WIRE SHALL RUN FROM A 1 POUND MAGNESIUM ANODE PLACE ADJACENT TO THE SADDLE TAP CONNECTION AT THE MAIN AND TERMINATE IN A FLUSH MOUNTED TRACER BOX.
8. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN TRACER WIRE SHALL BE WITH SPLIT BOLT CONNECTORS. WIRES NUTS ARE NOT ACCEPTABLE. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

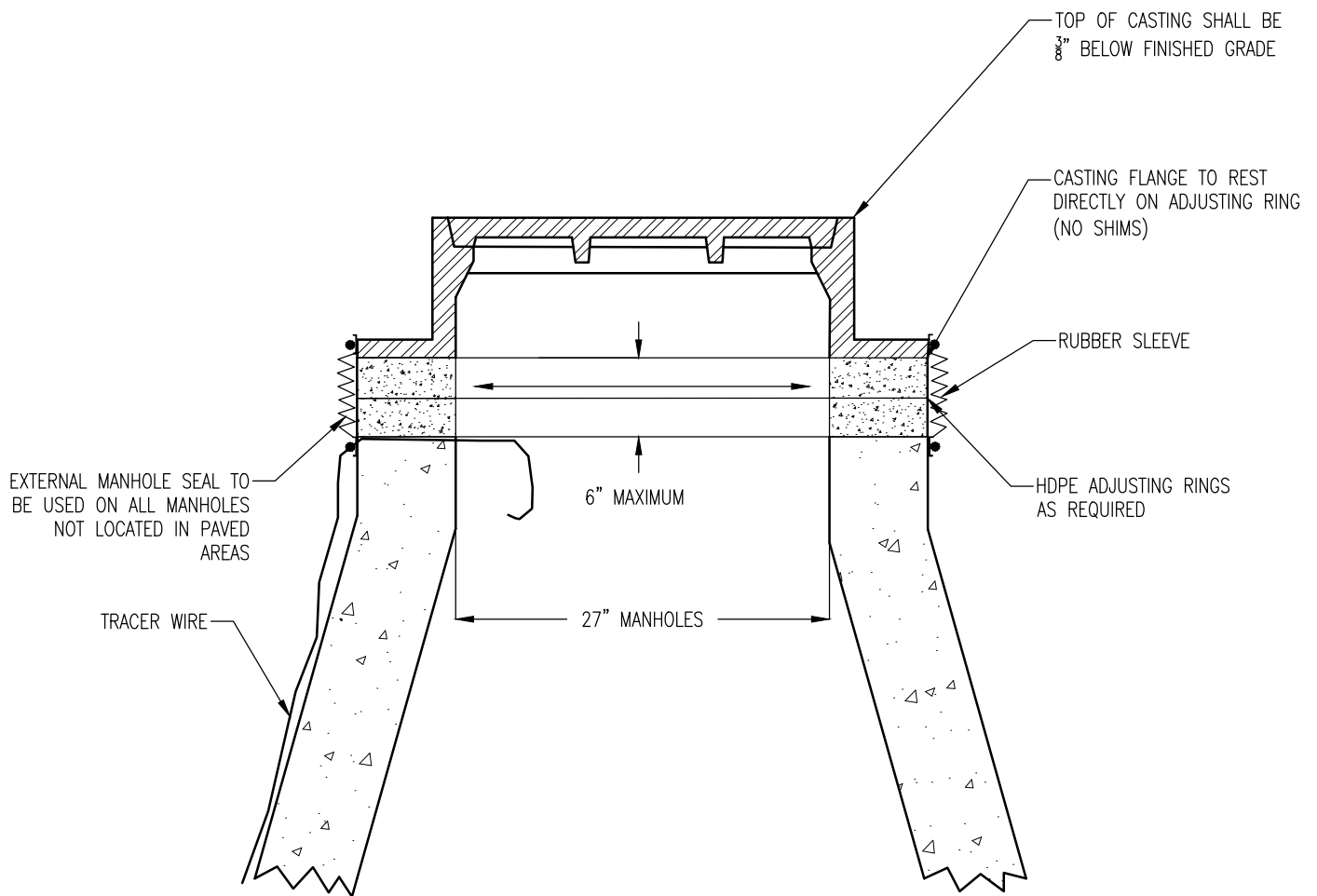
SEWER SERVICE CONNECTION FOR CIPP LINED SEWER MAIN

SAN-2A

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTE:

1. ALL SEALS SHALL EXTEND FROM THE CASTING TO THE CONE
2. TRACER WIRE REQUIRED ON ALL SANITARY SEWER MAINS

SANITARY MANHOLE NON-PAVED AREAS

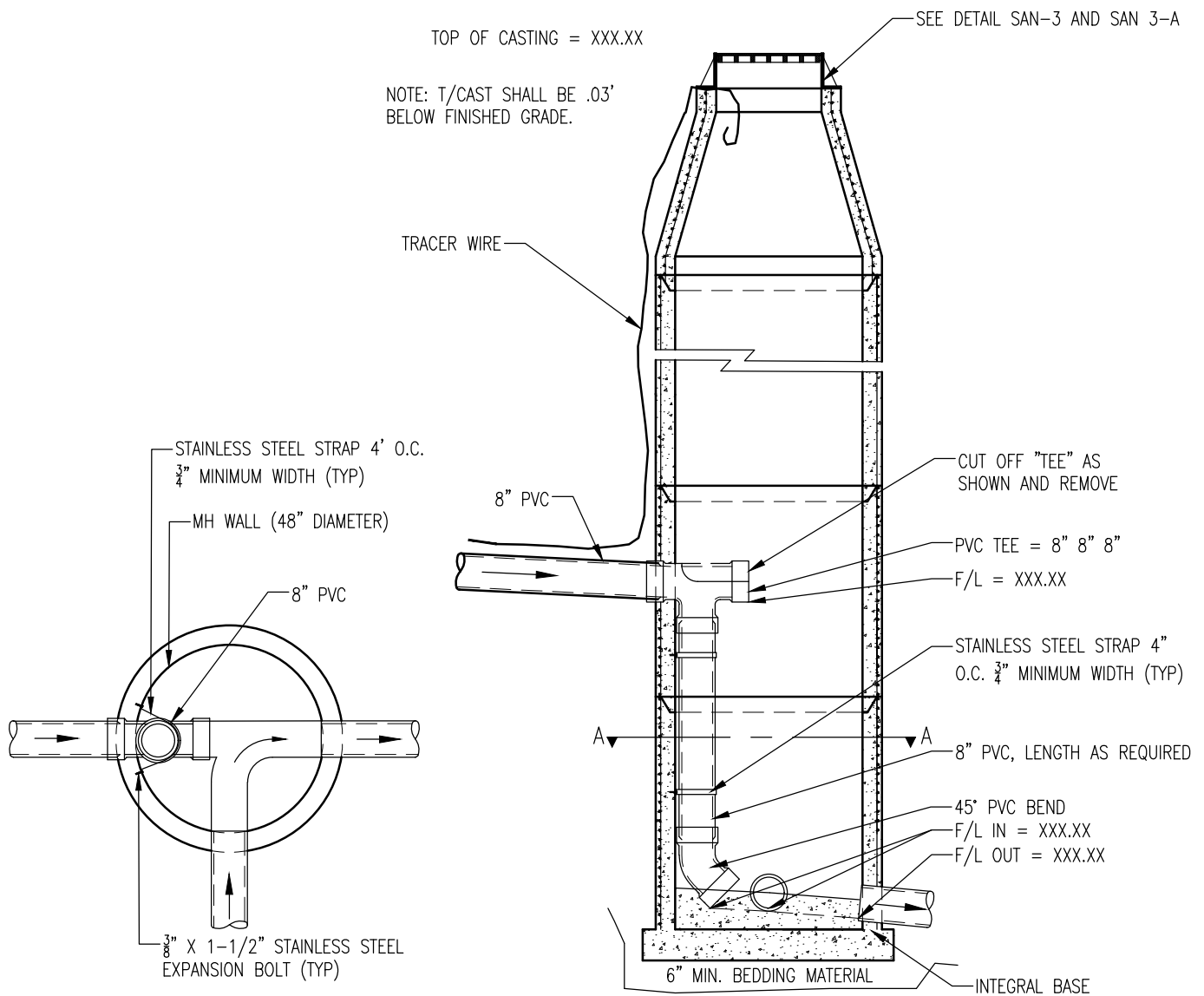
SAN-3

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

CONCRETE ENCASED CASTING COLLAR FOR SANITARY MH IN ROADWAY, WALKS, & DRIVES		SAN-3A
REVISED/APPROVED 04/05/2019	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



NOTES: REFER TO PLAN/PROFILES FOR ELEVATIONS

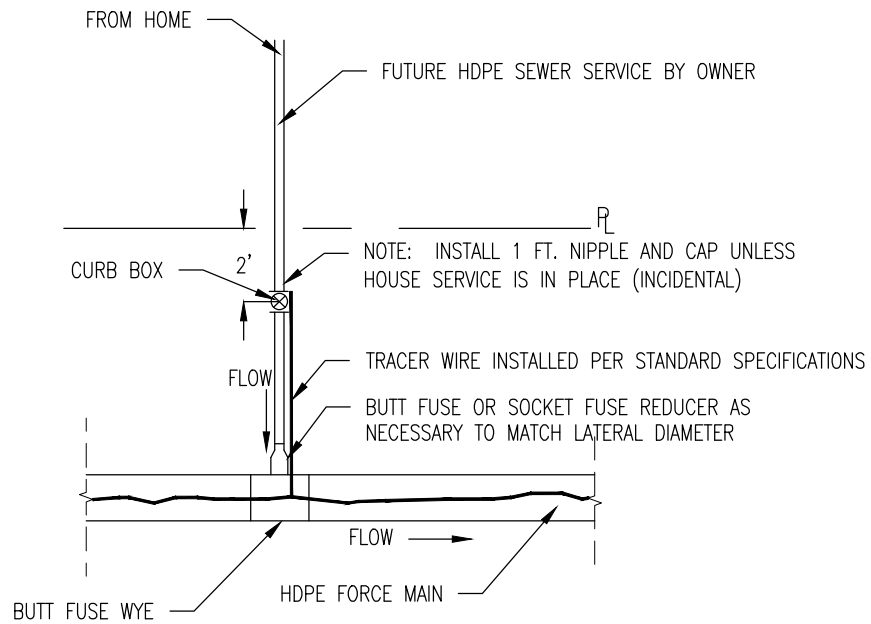
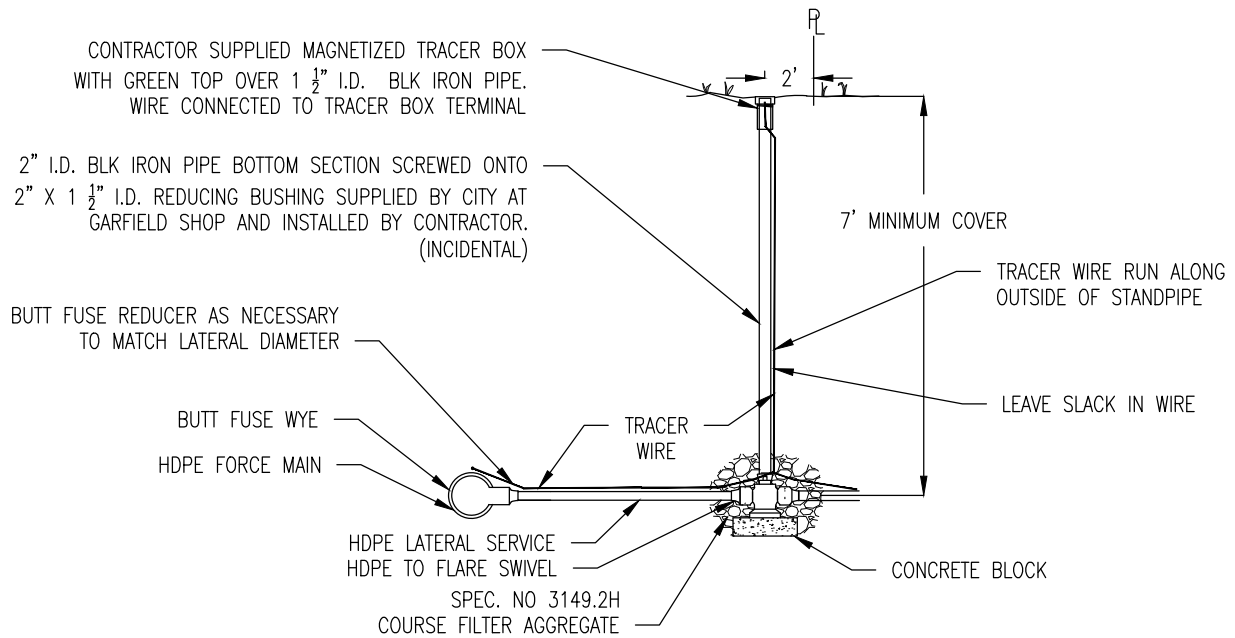
CONSTRUCT INSIDE DROP STRUCTURE

SAN-4

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. #12 GAUGE GREEN INSULATED COPPER TRACER WIRE SHALL BE INSTALLED WITH THE NON-CONDUCTIVE SERVICE PIPE. TRACER WIRE INSTALLATION REQUIRES ACCESS POINTS AT LEAST EVERY 300 FEET.
2. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.
3. TRACER WIRE SHALL RUN FROM THE WYE AND TERMINATE IN A FLUSH MOUNTED TRACER BOX WITH A GREEN CAST IRON TOP.

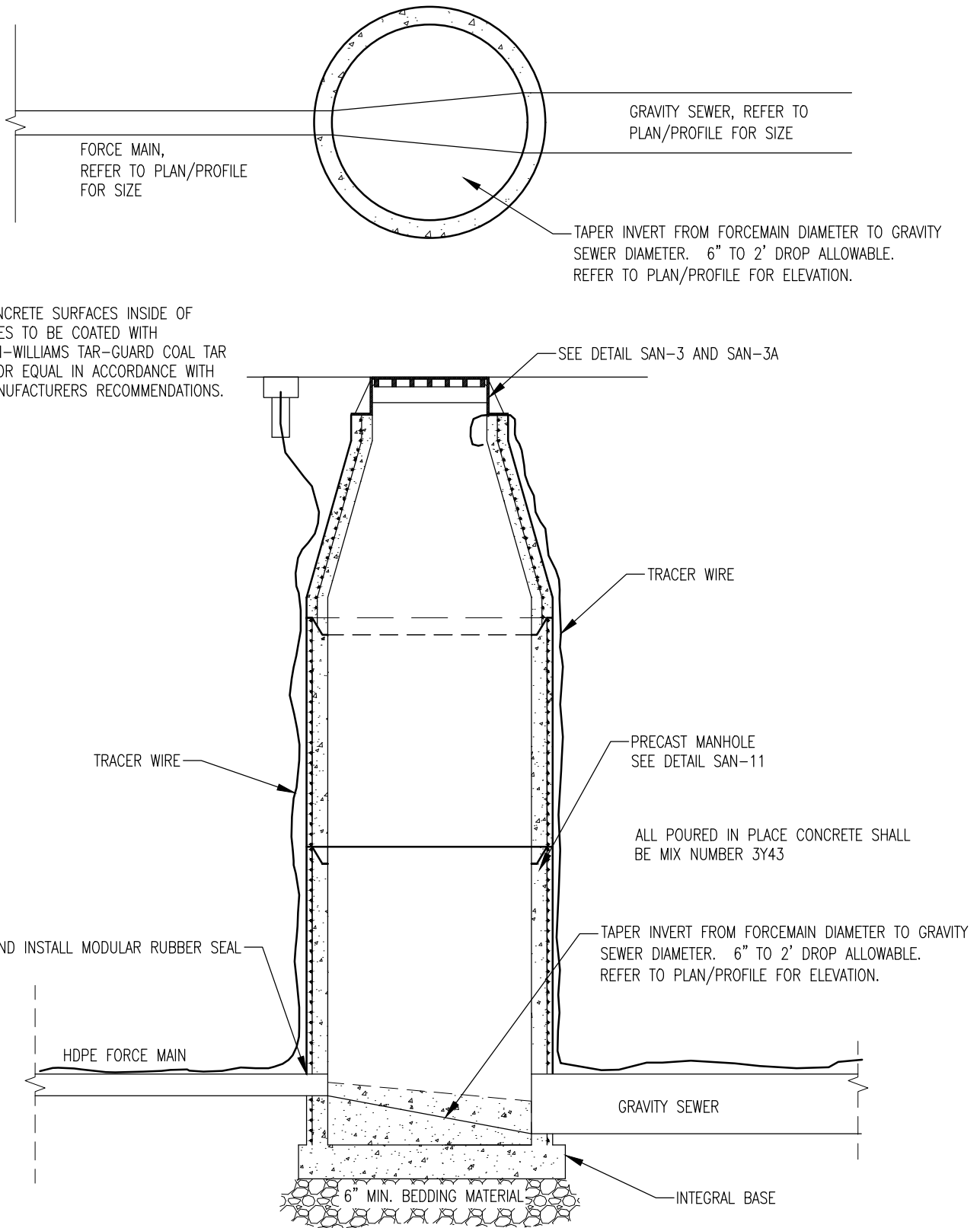
HDPE SANITARY SEWER PRESSURE LATERAL CONNECTION

SAN-5

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



HDPE FORCEMAIN TO GRAVITY MAIN MANHOLE

SAN-6

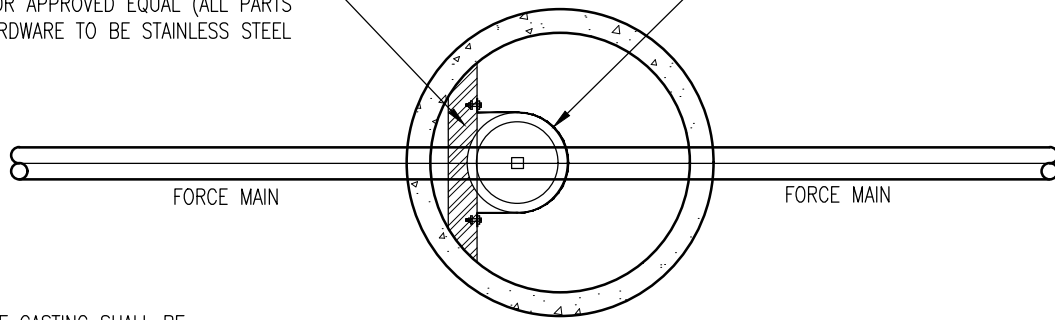
REVISED/APPROVED 01/08/2016

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

1 1/2" X 1 1/2" S.S. SUPPORT BRACKETS WITH
S.S. BAND OR APPROVED EQUAL (ALL PARTS
AND HARDWARE TO BE STAINLESS STEEL)

AIR VACUUM RELEASE VALVE



FORCE MAIN

FORCE MAIN

NOTE: TOP OF CASTING SHALL BE
.03' BELOW FINISHED GRADE

SEE DETAIL SAN-3 AND SAN-3A

MAGNETIZED TRACER WIRE BOX

6" POLYSTYRENE INSULATION
BOARD (DOW STYROFOAM HI 40,
CERTIFOAM 40, OR EQUIVALENT)

1/2" TREATED PLYWOOD SUPPORTED
BY 1" S.S. ANGLE IRON W/
STAINLESS LAG BOLTS

INCIDENTAL TO MH CONSTRUCTION

ALL POURED IN PLACE CONCRETE SHALL
BE MIX NUMBER 3Y43

8' X 8' X 3"
POLYSTYRENE INSULATION

MAGNETIZED TRACER WIRE BOX

PRECAST MANHOLE
SEE DETAIL SAN-11

3" X 12" X 4'
INSULATION STRIPS

1 1/2" X 1 1/2" S.S. SUPPORT
BRACKET WITH S.S. BAND OR
APPROVED EQUAL

TRACER WIRE

TRACER WIRE

AIR VACUUM RELEASE VALVE
APCO MODEL 443, VAL-MATIC
801WA, OR APPROVED EQUAL

ELECTROFUSION SERVICE
SADDLE WITH 2" BRASS INSERT

CORE DRILL AND INSTALL
MODULAR RUBBER SEAL

2" GALVANIZED IRON PIPE

2" PE FULLY PORTED THREADED
BALL VALVE

HDPE FORCE MAIN

HDPE FORCE MAIN

CONCRETE SUPPORT,
MIN. 8" HIGH

6" MIN. BEDDING MATERIAL

INTEGRAL BASE

NOTE: MANHOLE TO MEET ALL REQUIREMENTS OF SAN-11

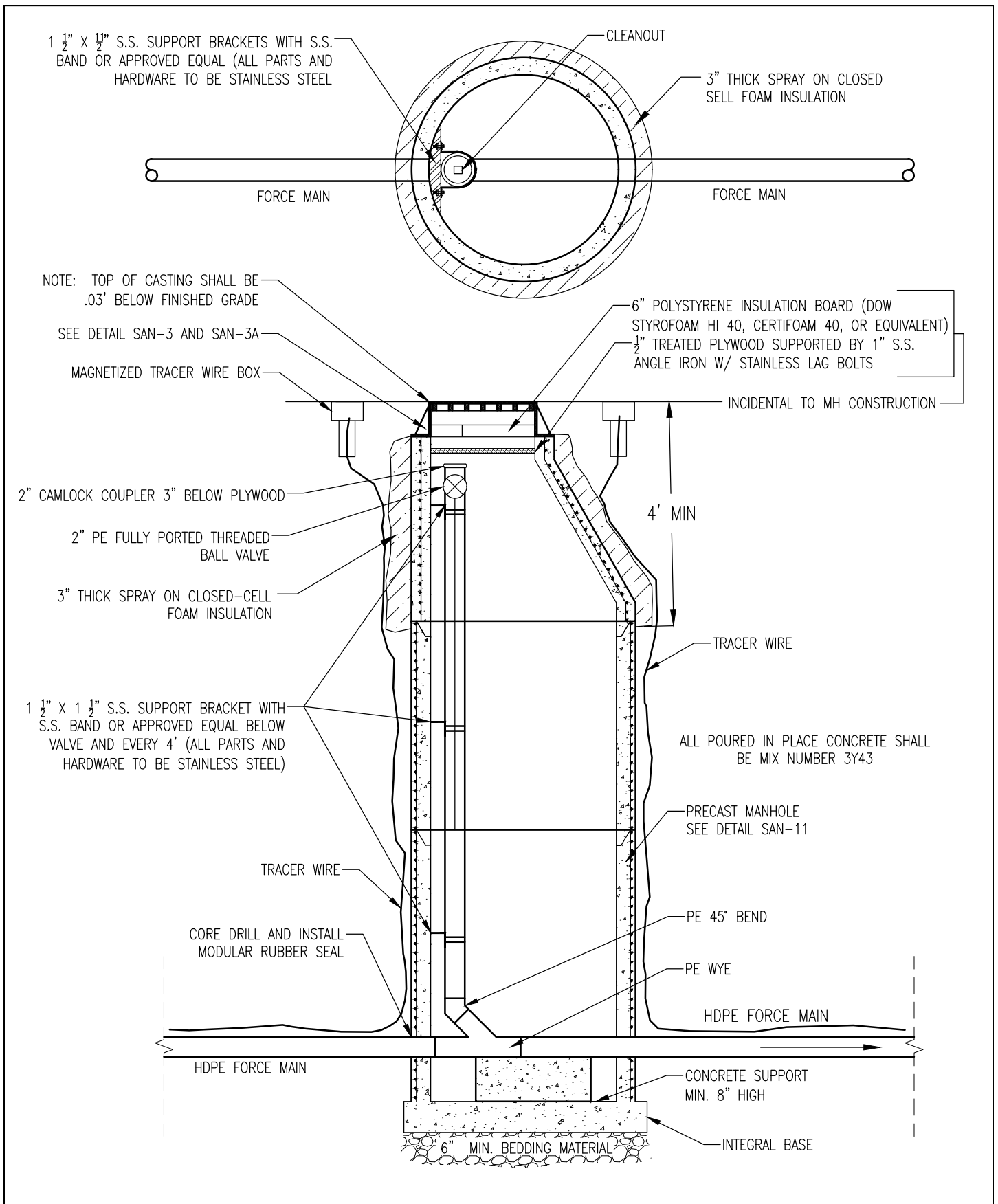
AIR-RELEASE MANHOLE

SAN-7

REVISED/APPROVED 01/08/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



CLEANOUT MANHOLE

SAN-8

REVISED/APPROVED 04/05/2019

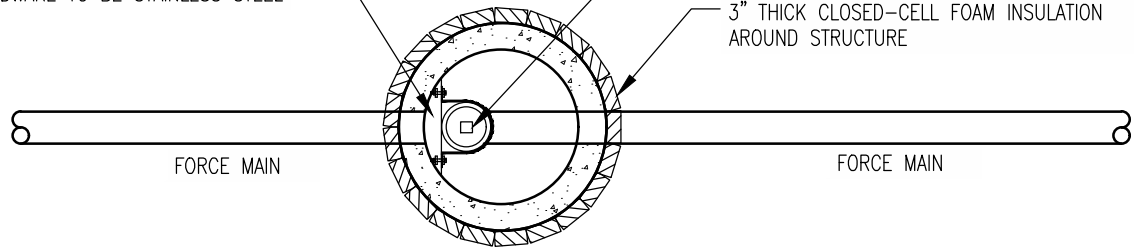
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

1-1/2" X 1-1/2" S.S. SUPPORT BRACKETS
WITH S.S. BAND OR APPROVED EQUAL (ALL
PARTS AND HARDWARE TO BE STAINLESS STEEL)

CLEANOUT (DEAD END)

3" THICK CLOSED-CELL FOAM INSULATION
AROUND STRUCTURE



NOTE: TOP OF CASTING SHALL BE
.03' BELOW FINISHED GRADE

SEE DETAIL SAN-3/SAN-3A

MAGNETIZED TRACER WIRE BOX

6" POLYSTYRENE INSULATION
BOARD (DOW STYROFOAM HI 40,
CERTIFOAM 40, OR EQUIVALENT)

1/2" TREATED PLYWOOD SUPPORTED
BY 1" S.S. ANGLE IRON W/
STAINLESS LAG BOLTS

THESE ITEMS ARE INCIDENTAL TO
HANDHOLE CONSTRUCTION AND
SHALL BE CUSTOM FIT TO
ACHIEVE MANHOLE INSULATION
AND MAINTAIN ACCESSIBILITY.

PE PIPE END THREADED PLUG
3" BELOW PLYWOOD

2" PE FULLY PORTED THREADED
BALL VALVE

STRUCTURE COATED WITH 3" THICK SPRAY
ON CLOSED-CELL FOAM INSULATION

48" DEEP 30" DIAMETER PRECAST MANHOLE
(MNDOT STANDARD PLATE 4005M) DESIGN "F"
W/O CONCRETE BASE

1-1/2" X 1-1/2" S.S. SUPPORT BRACKET
WITH S.S. BAND OR APPROVED EQUAL
BELOW VALVE (ALL PARTS AND HARDWARE
TO BE STAINLESS STEEL)

2" HDPE SANITARY FORCEMAIN

TRACER WIRE

GRANULAR BACKFILL

HDPE FORCE MAIN

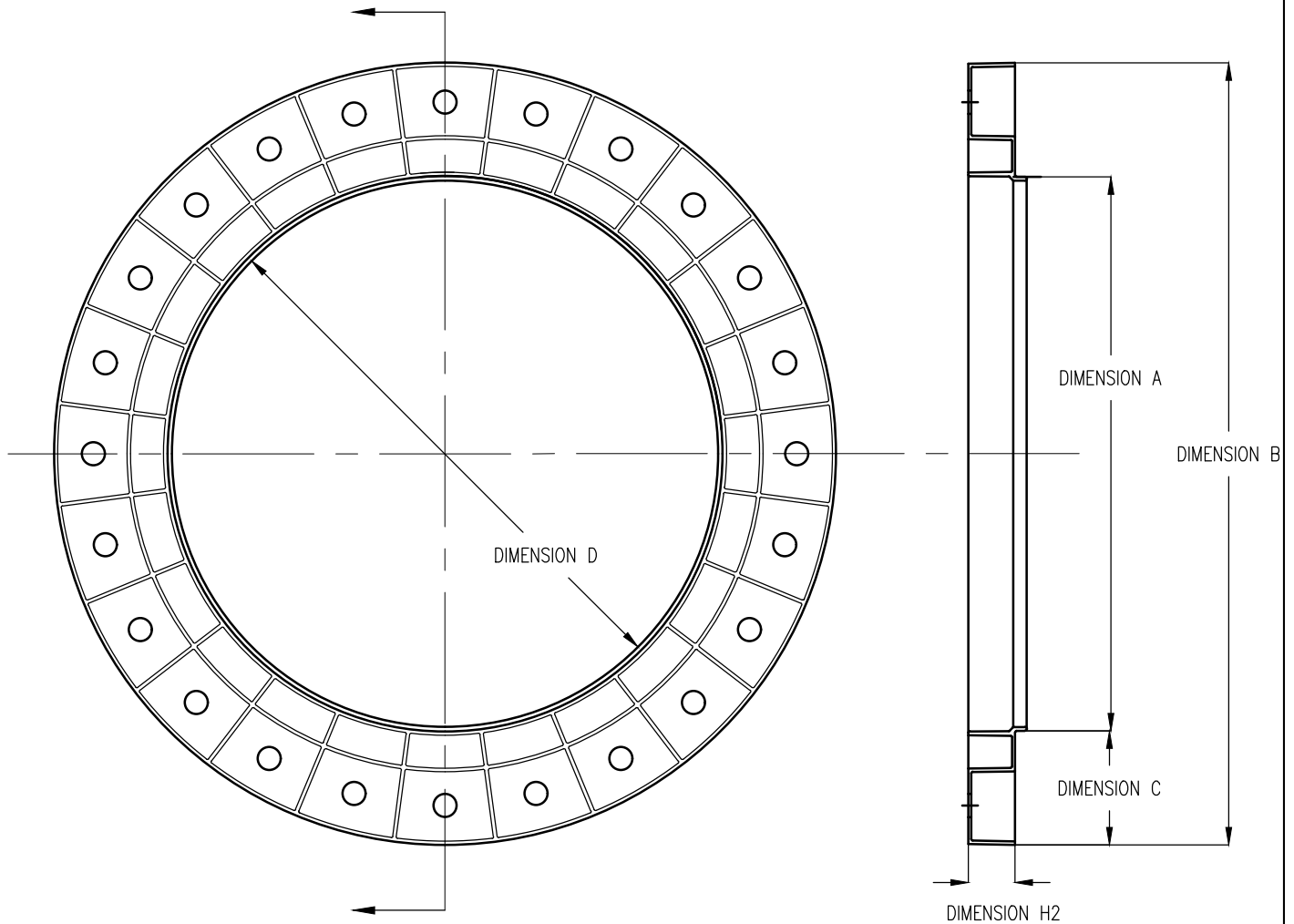
DEAD END CLEANOUT HAND HOLE

SAN-8A

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



DIMENSION SCHEDULE

CONE SIZE	DIMENSION A	DIMENSION B	DIMENSION C	DIMENSION D	DIMENSION H1
27.00	26.75	36.50	5.00	26.25	1.20, 1.50, 2.00, 4.00

DESCRIPTION

1. PLASTIC INJECTION MOLDED ADJUSTMENT RING
2. MOLDED FROM HIGH DENSITY POLYETHYLENE AS DEFINED IN ASTM SPECIFICATION D1248
3. ACTUAL RESIN PROPERTIES WILL VARY ALLOWING FOR THE UTILIZATION OF A MAXIMUM PERCENT OF RECYCLED MATERIAL
4. THE PERCENT OF POST CONSUMER WASTE TO INDUSTRIAL WASTE WILL VARY WITH AVAILABILITY AND PROPERTY RETENTION NEEDS
5. COLOR, SHADE AND UNIFORMITY WILL VARY WITH THE MIX OF THE POST CONSUMER AND INDUSTRIAL WASTE MATERIALS
6. DIMENSIONS SHOWN ARE NOMINAL – ACTUAL SIZE WILL VARY WITHIN ALLOWABLE TOLERANCE AND REQUIRED FIT

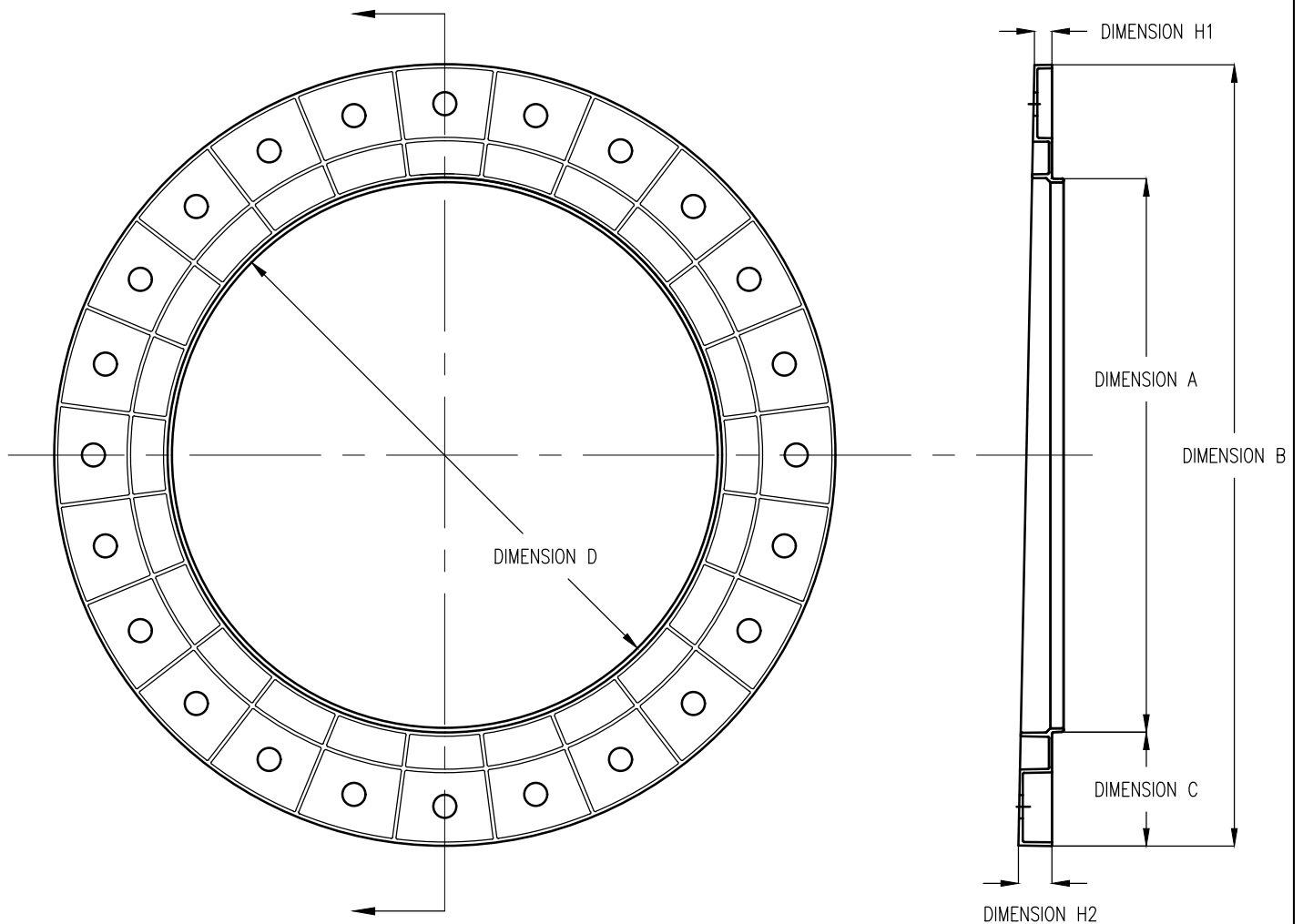
POLYETHYLENE MH ADJUSTING RING – FLAT

SAN-9

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



DIMENSION SCHEDULE

CONE SIZE	DIMENSION A	DIMENSION B	DIMENSION C	DIMENSION D	DIMENSION H1-H2
27.00	26.75	36.50	5.00	26.25	0.75 - 1.50

DESCRIPTION

1. PLASTIC INJECTION MOLDED ADJUSTMENT RING
2. MOLDED FROM HIGH DENSITY POLYETHYLENE AS DEFINED IN ASTM SPECIFICATION D1248
3. ACTUAL RESIN PROPERTIES WILL VARY ALLOWING FOR THE UTILIZATION OF A MAXIMUM PERCENT OF RECYCLED MATERIAL
4. THE PERCENT OF POST CONSUMER WASTE TO INDUSTRIAL WASTE WILL VARY WITH AVAILABILITY AND PROPERTY RETENTION NEEDS
5. COLOR, SHADE AND UNIFORMITY WILL VARY WITH THE MIX OF THE POST CONSUMER AND INDUSTRIAL WASTE MATERIALS
6. DIMENSIONS SHOWN ARE NOMINAL - ACTUAL SIZE WILL VARY WITHIN ALLOWABLE TOLERANCE AND REQUIRED FIT

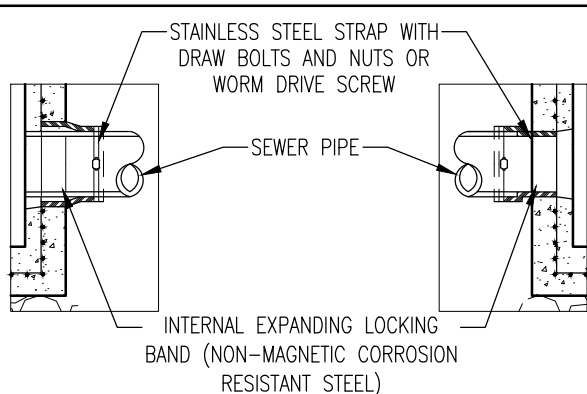
POLYETHYLENE MH ADJUSTING RING - WEDGE

SAN-10

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

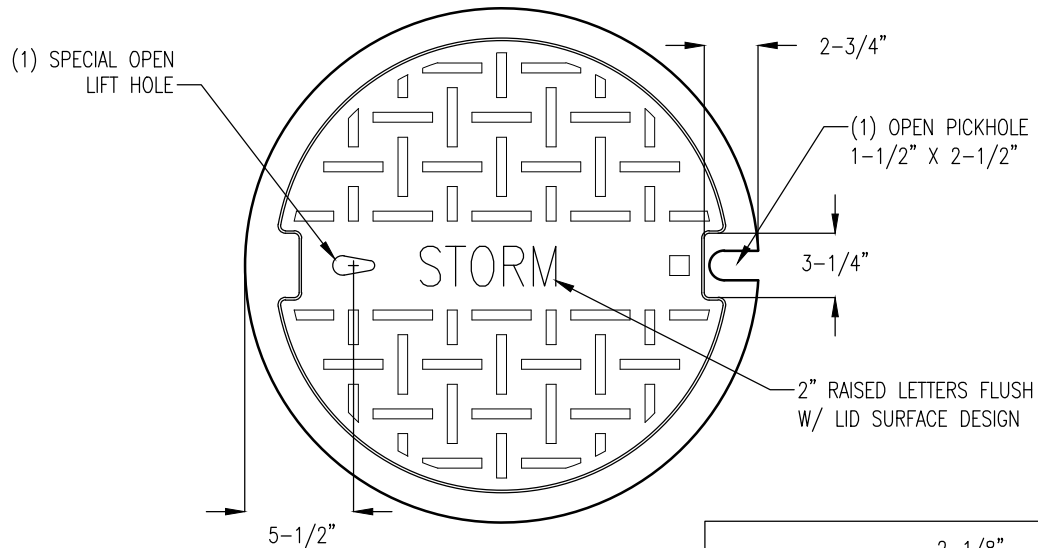
NO SCALE



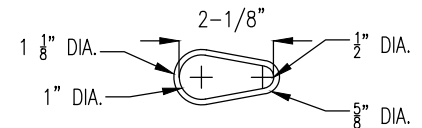
PRECAST MECHANICAL JOINT SEWER MANHOLE		SAN-11
REVISED/APPROVED 01/08/2016	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE

WEIGHT 298 LBS		MATL. GRAY IRON CLASS 35B
WEIGHT 122 LBS	TOTAL WEIGHT 420 LBS.	SPEC. ASTM A-48-74

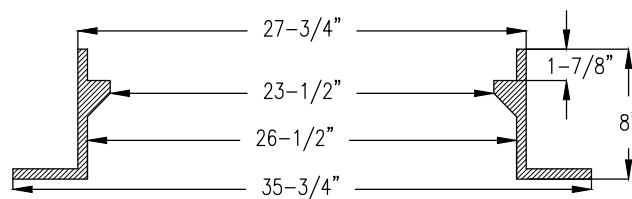
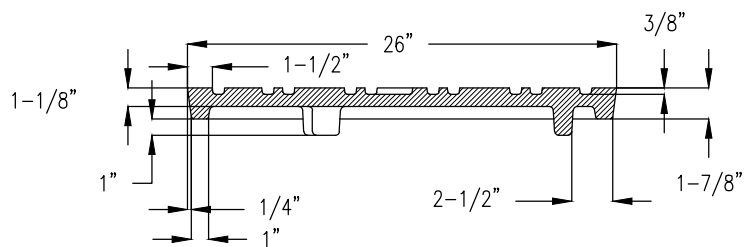
NOTE: SUITABLE FOR HS25 WHEEL LOADS



NOTE: T/CAST SHALL BE .03' BELOW FINISHED PAVEMENT SURFACE.



DETAIL OF SPECIAL LIFT HOLE



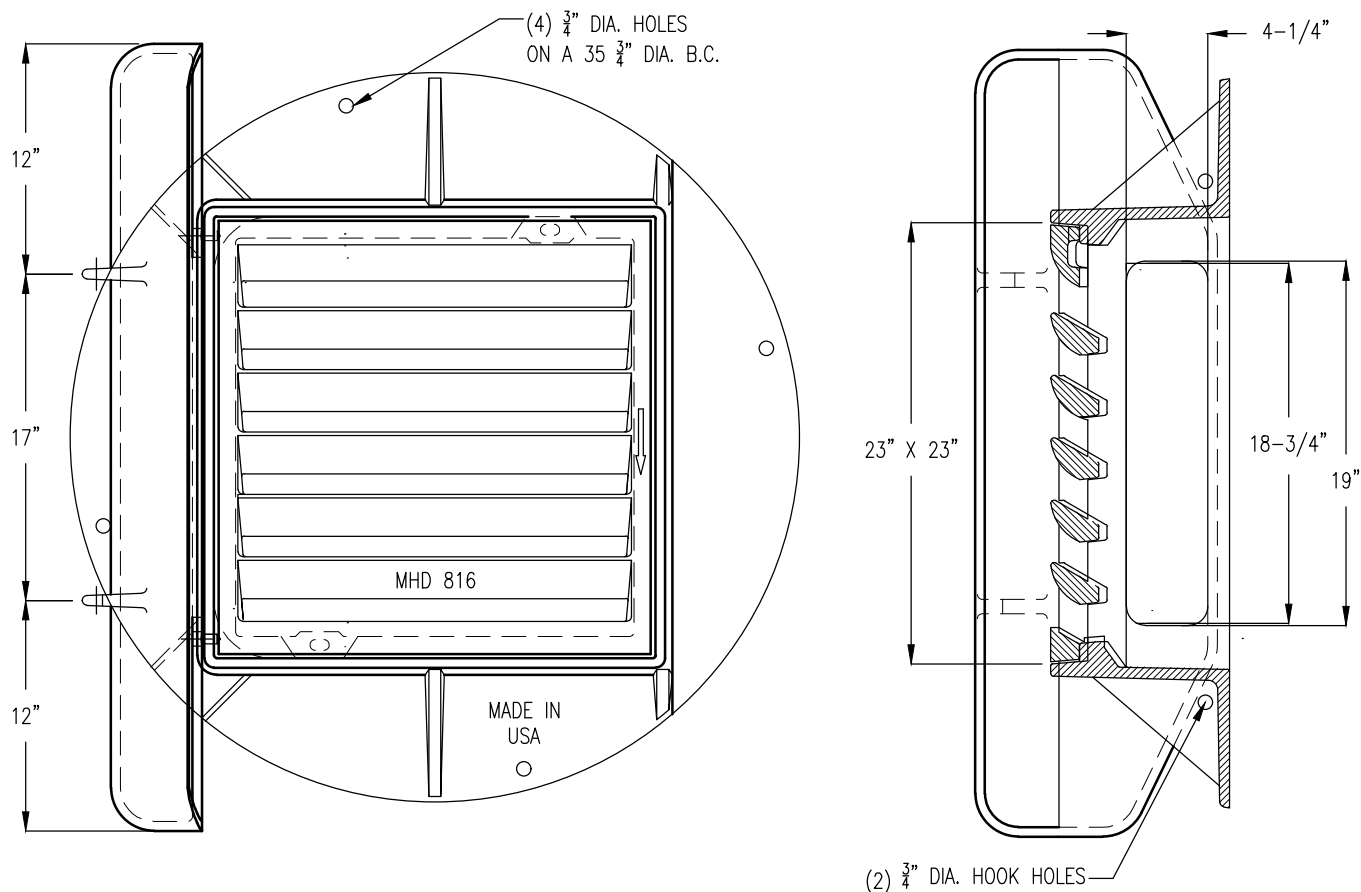
STORM MANHOLE CASTING

STRM-1

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. COMPONENT NO'S: FRAME 5002, GRATE MHD 816 (STD PLATE 4154), CURB BOX 823A (STD PLATE 4160).
2. MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
3. WEIGHT: FRAME APPROX. 257#, GRATE 131#, CURB BOX 105#.
4. ALL GUTTERS UPSTREAM OF CATCH BASINS SHALL BE STAMPED, "NO DUMPING, LEADS TO LAKE" WITH A CITY SUPPLIED STAMP.

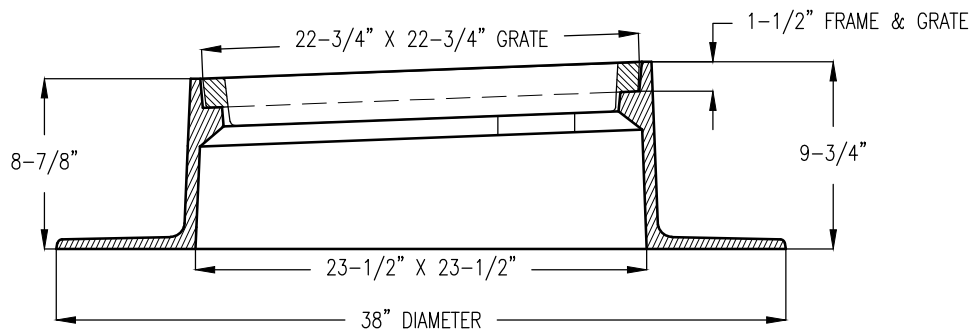
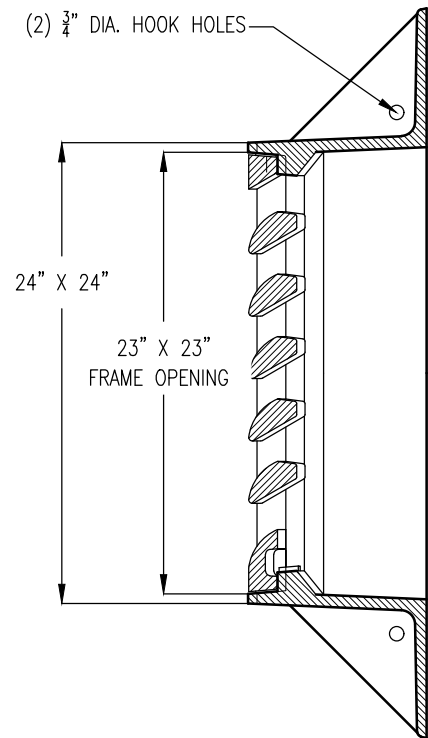
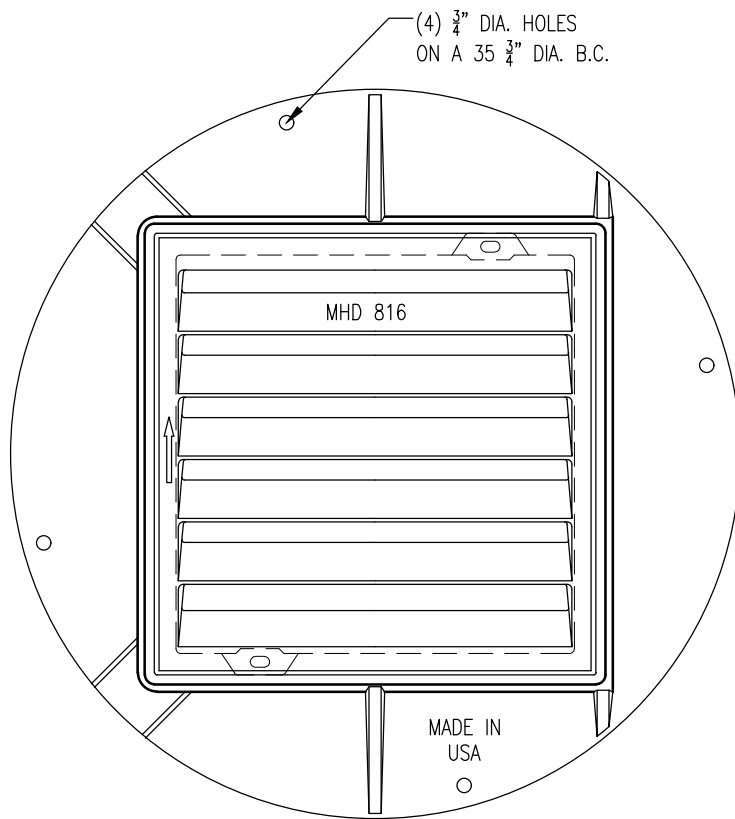
CATCH BASIN/CURB BOX CASTINGS

STRM-2

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. COMPONENT NO'S: FRAME 5005, GRATE 816 (STD PLATE 4154).
2. MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
3. WEIGHT: FRAME 262#; GRATE 131#
4. ALL GUTTERS UPSTREAM OF CATCH BASINS SHALL BE STAMPED, "NO DUMPING, LEADS TO LAKE" WITH A CITY SUPPLIED STAMP.

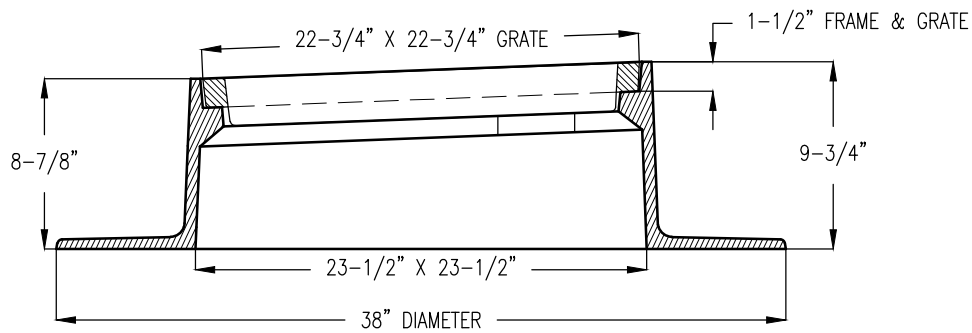
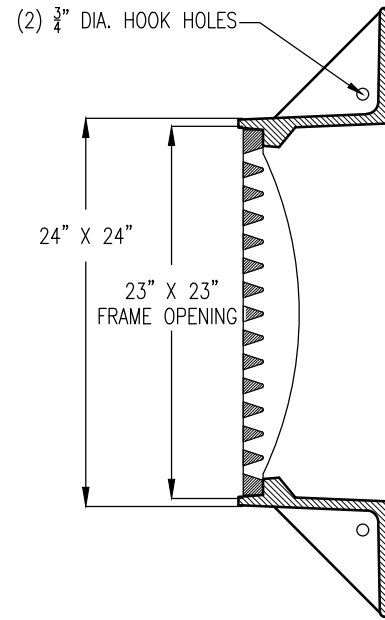
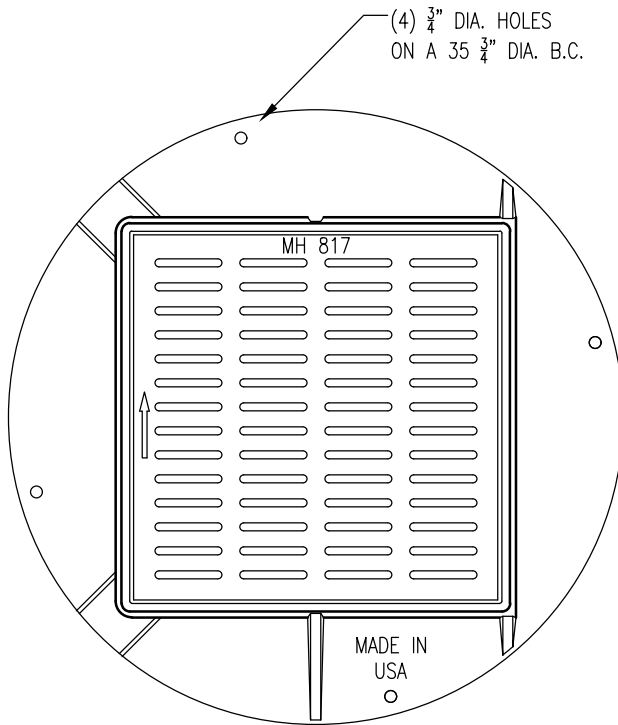
CATCH BASIN CASTINGS

STRM-3

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. COMPONENT NO'S: FRAME 5005, GRATE 817 (STD PLATE 4155).
2. MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
3. WEIGHT: FRAME 262#; GRATE 131#
4. ALL GUTTERS UPSTREAM OF CATCH BASINS SHALL BE STAMPED, "NO DUMPING, LEADS TO LAKE" WITH A CITY SUPPLIED STAMP.

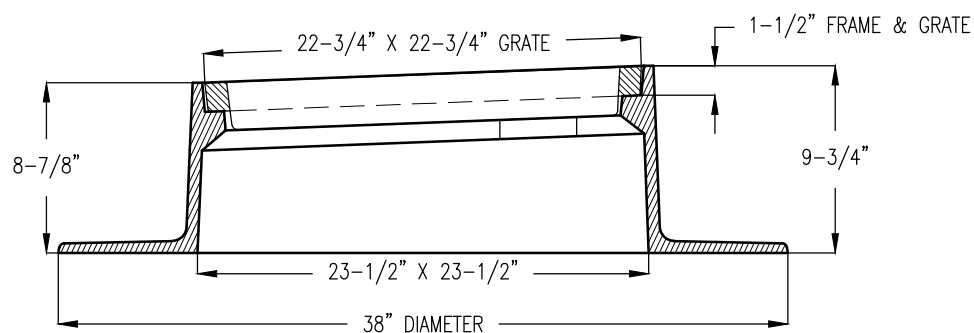
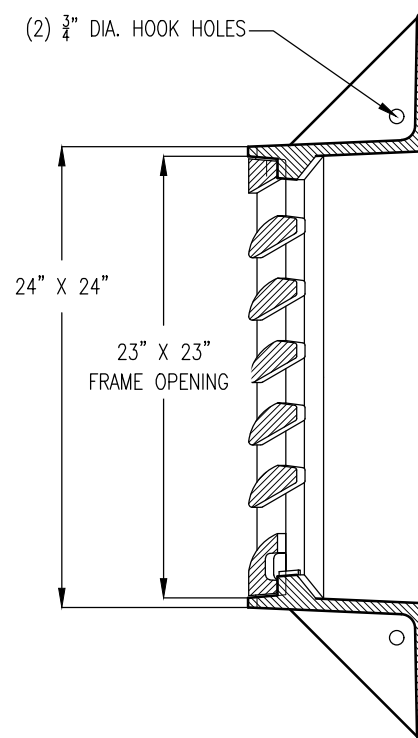
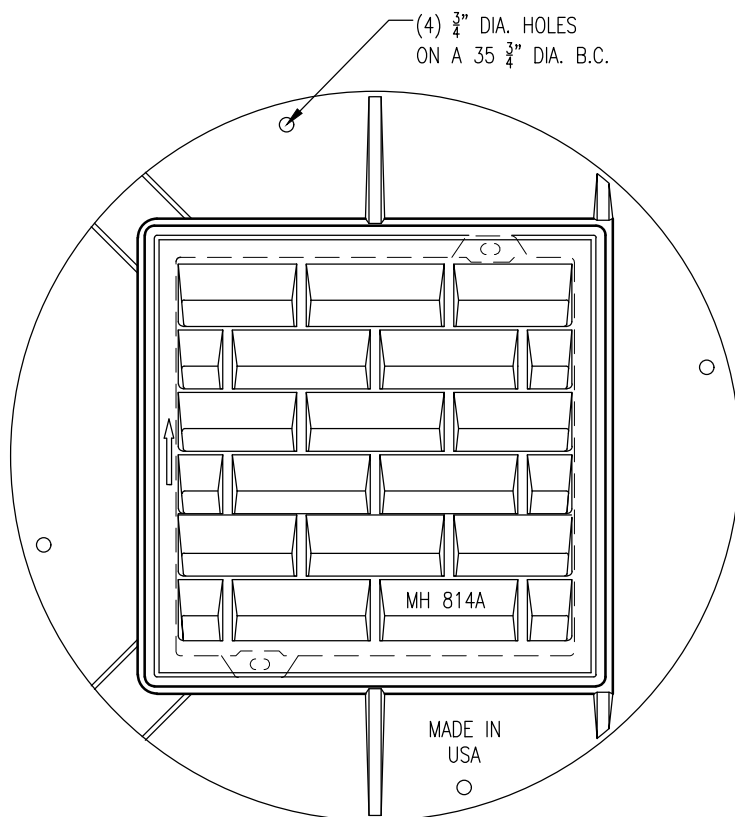
CATCH BASIN CASTINGS – ADA

STRM-3A

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. COMPONENT NO'S: FRAME 5005, GRATE 814A (STD PLATE 4152).
2. MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
3. WEIGHT: FRAME 262#; GRATE 131#
4. ALL GUTTERS UPSTREAM OF CATCH BASINS SHALL BE STAMPED, "NO DUMPING, LEADS TO LAKE" WITH A CITY SUPPLIED STAMP.

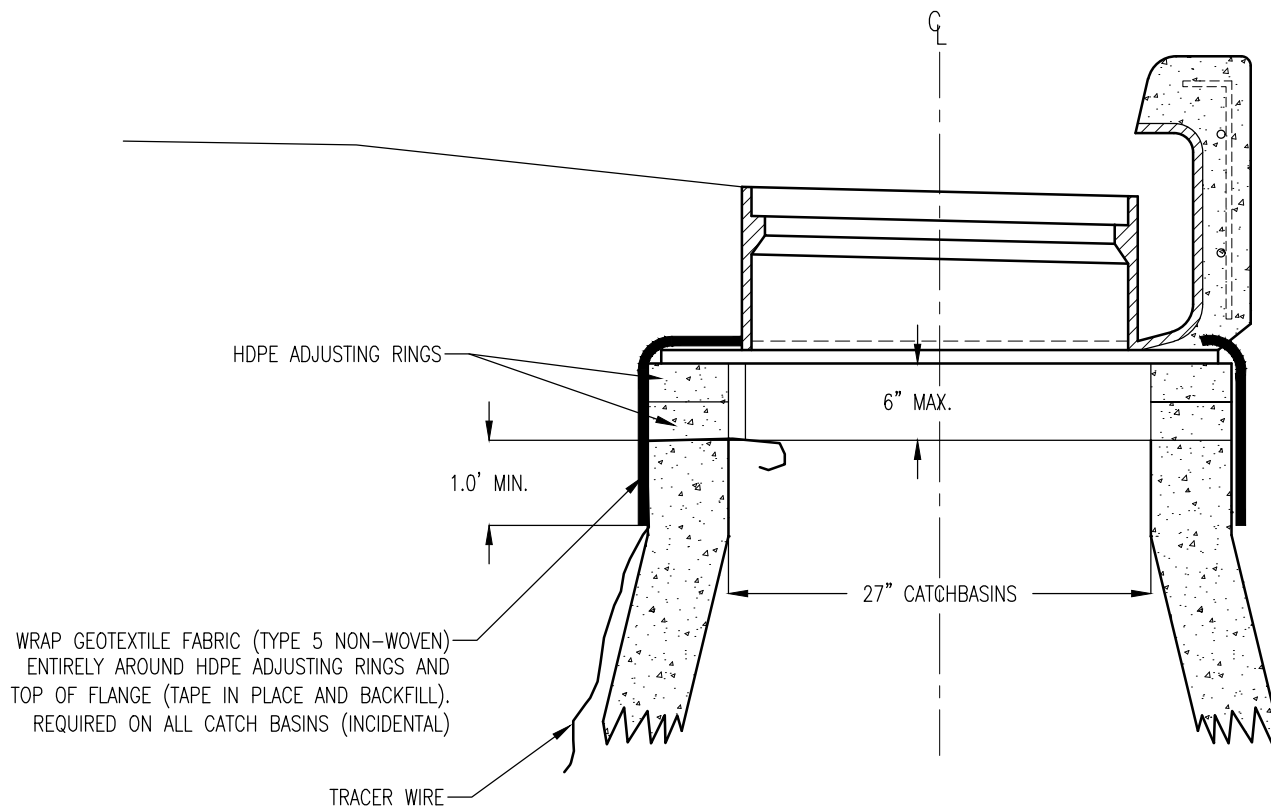
CATCH BASIN CASTINGS – BICYCLE SAFE

STRM-3B

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTE:
TRACER WIRE REQUIRED ON ALL PLASTIC STORM SEWER PIPES

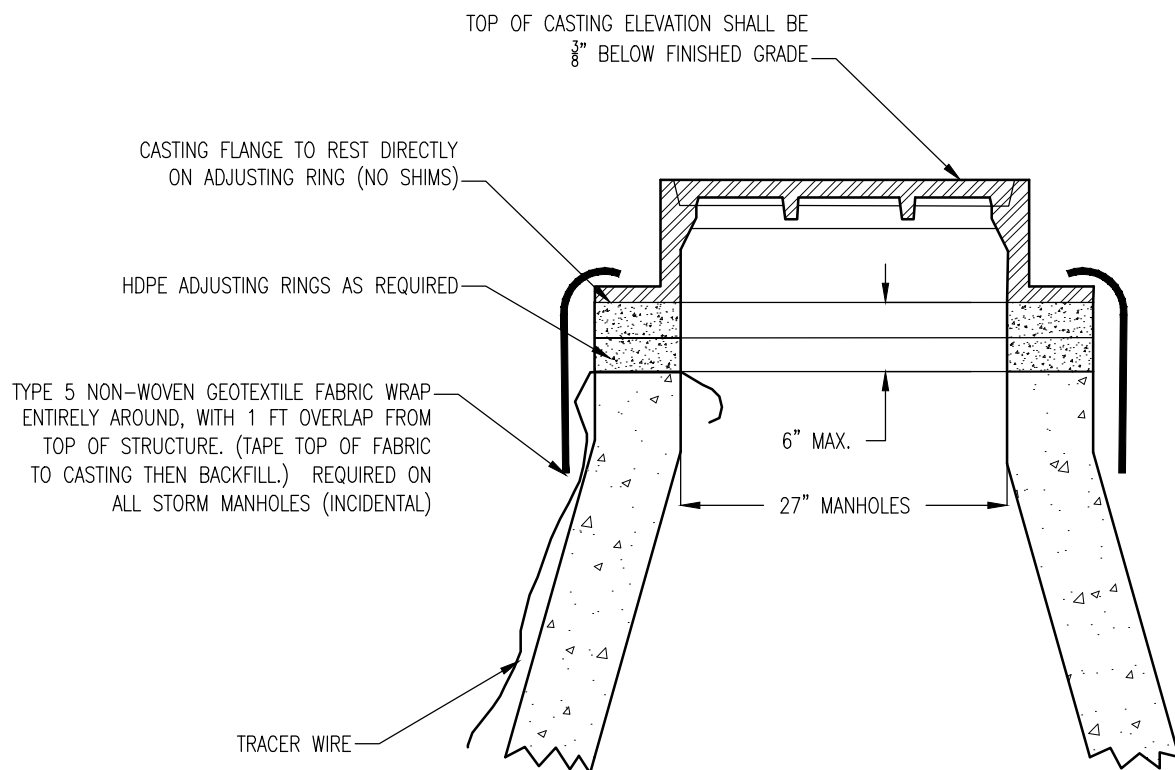
FABRIC WRAPPED CATCH BASIN CASTING

STRM-4

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTE:
TRACER WIRE REQUIRED ON ALL PLASTIC STORM SEWER PIPE

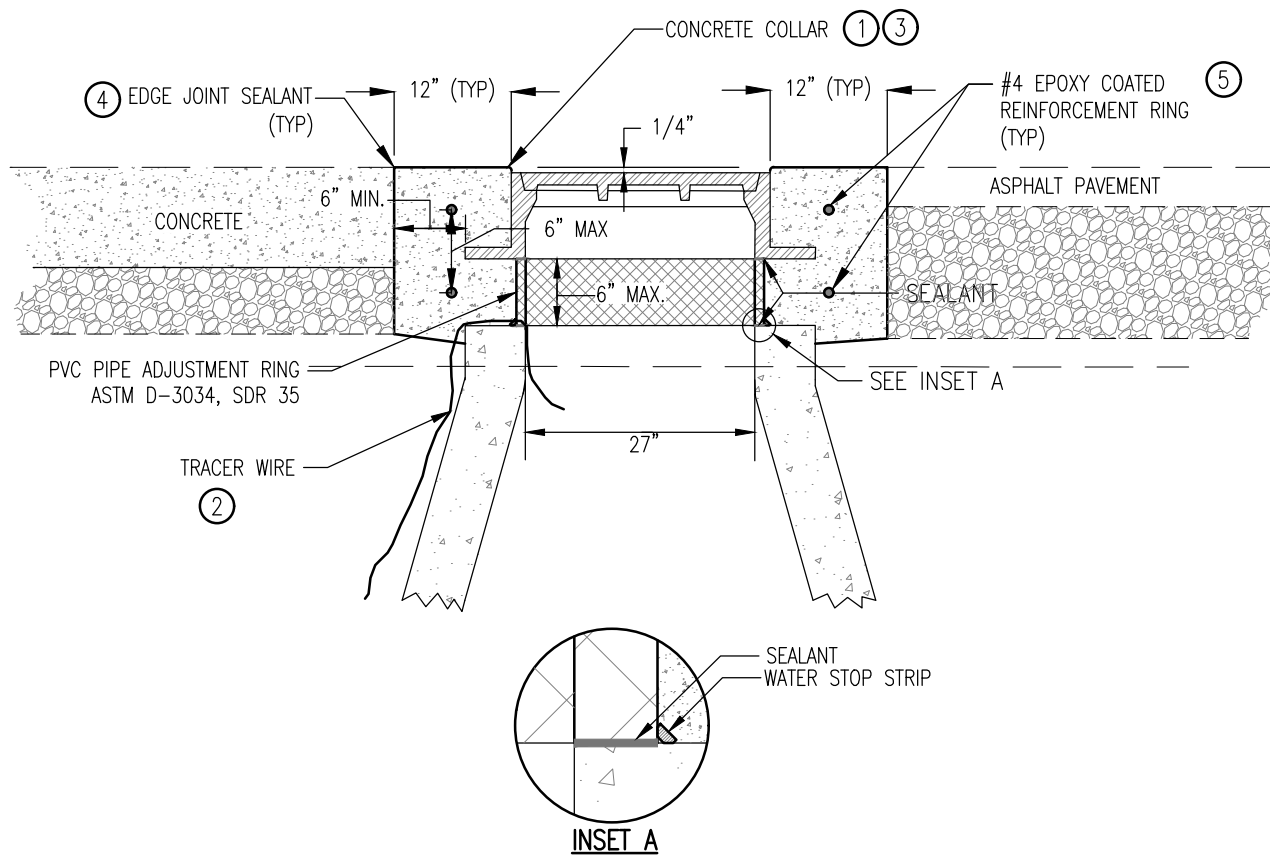
STORM MANHOLE NON-PAVED AREAS

STRM-5

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

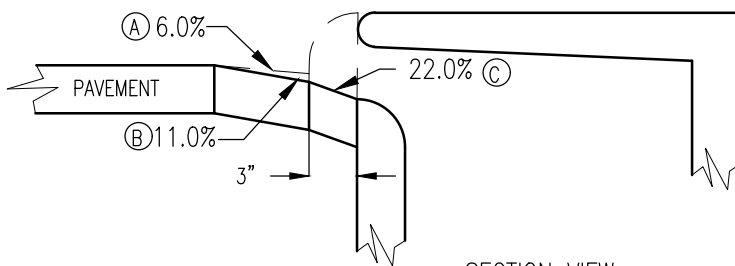
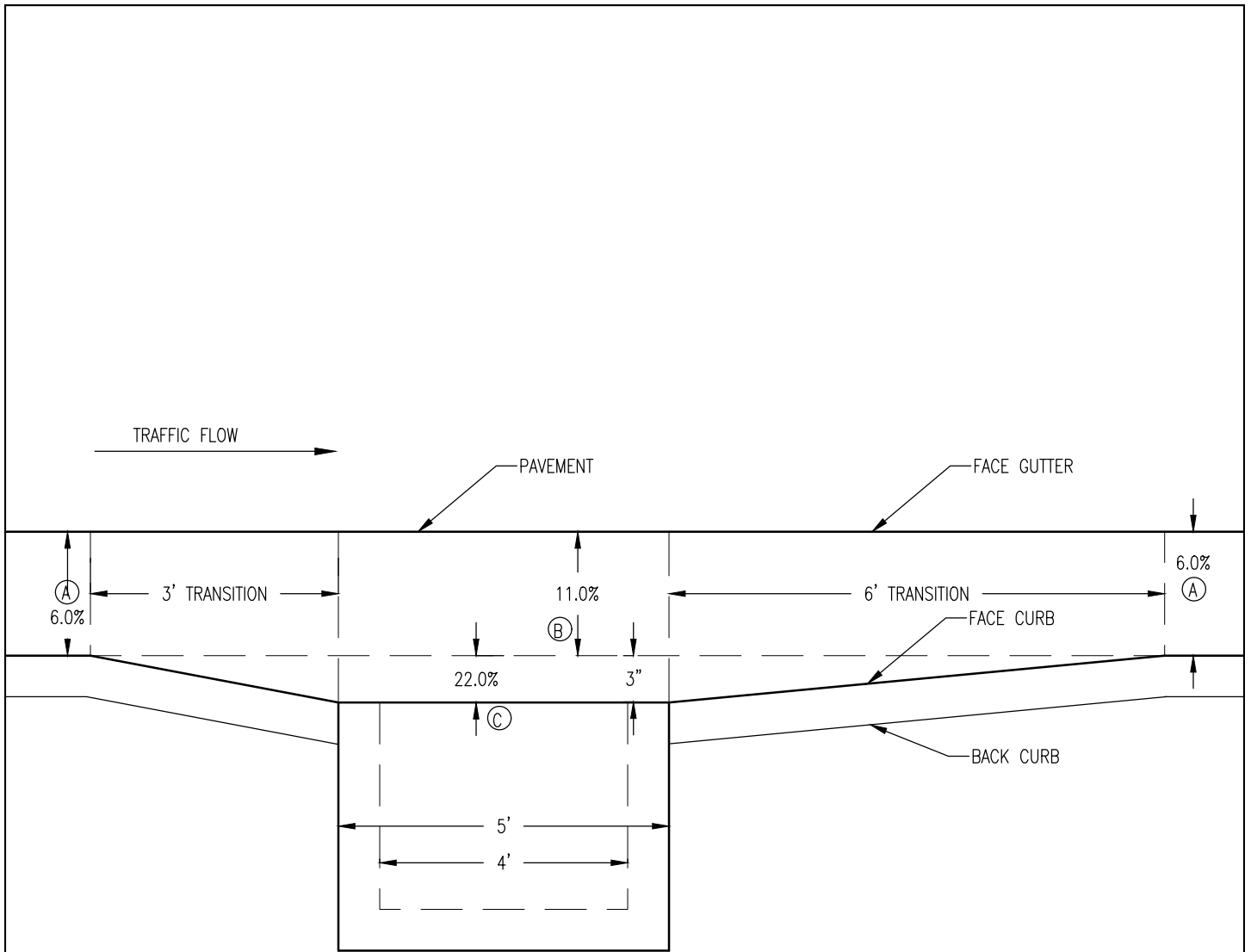


NOTES:

- ① CONCRETE (MIX NO. 3G52) COLLAR TO ENCASE CASTING AND ADJUSTMENT RING.
- ② TRACER WIRE, IF REQUIRED, FOR PLASTIC PIPE ON PROJECT
- ③ CONCRETE COLLAR SHALL BE CIRCULAR LAYOUT. PAVEMENT AND BASE SHALL BE CUT OUT WITH ROTATING CUTTING DEVICE
- ④ FINISH CONCRETE EDGE WITH 1/4" RADIUS. SEAL JOINT BETWEEN PAVEMENT AND COLLAR.
- ⑤ MAINTAIN 3.5" COVER ON REINFORCEMENT.

NOT TO SCALE

CONCRETE ENCASED CASTING COLLAR FOR STORM MH IN ROADWAY, WALKS, & DRIVES		STRM-5A
REVIEWED/APPROVED 04/05/2019	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



SEE STANDARD PLATE 4021 FOR
CATCH BASIN CONSTRUCTION DETAILS.

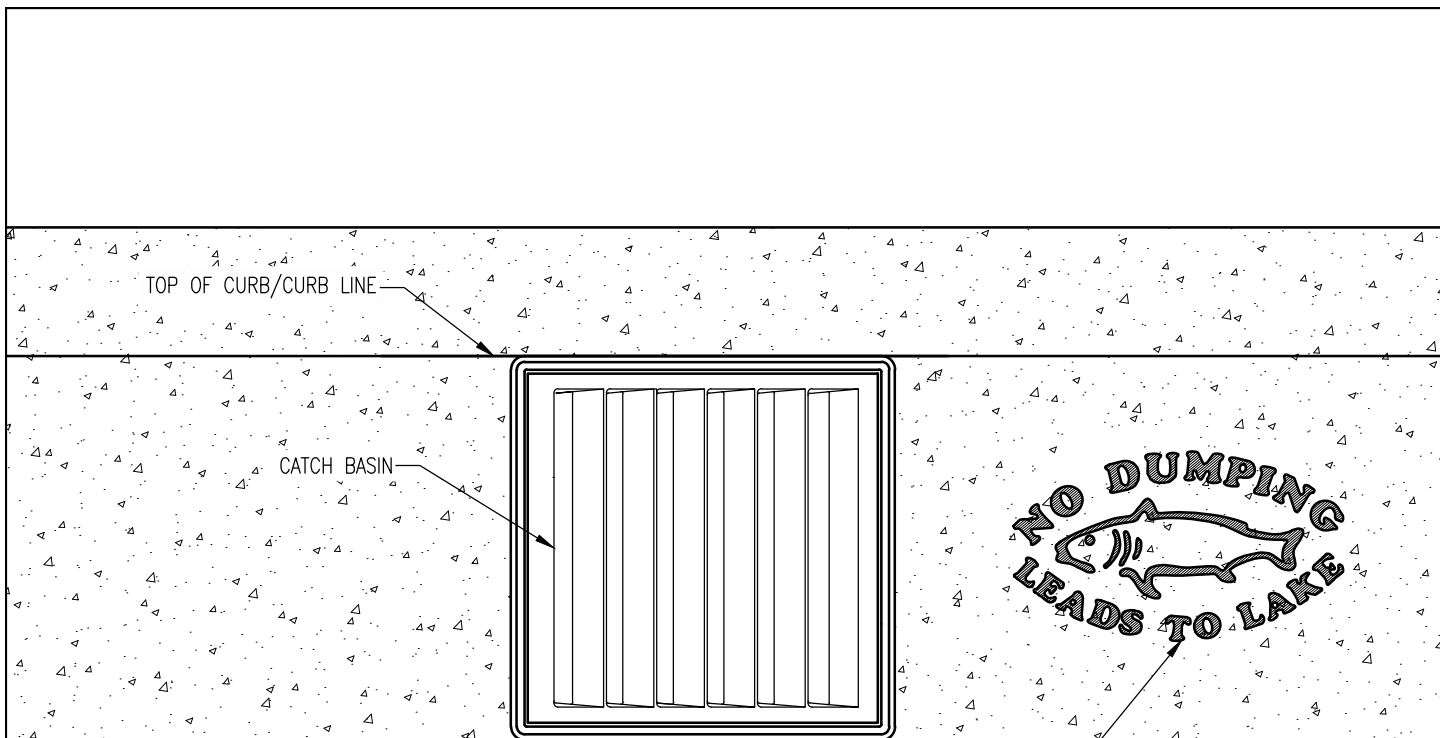
GUTTER SWALE

STRM-6

REVIEWED/APPROVED 04/05/2019

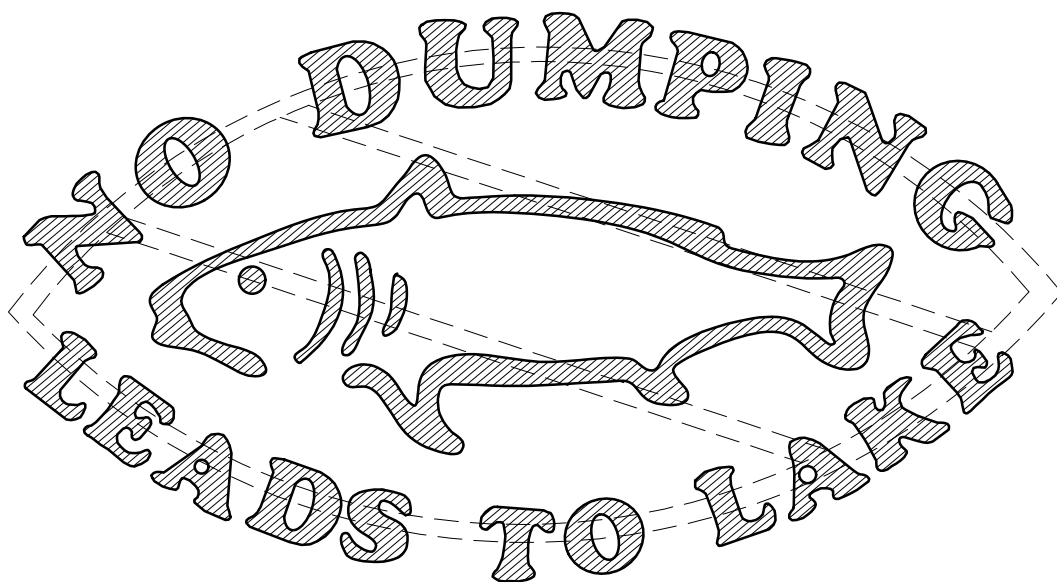
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



GUTTER STAMP TO BE PLACED A MAXIMUM OF 18" FROM CATCH
BASIN GRATE ON UPHILL SIDE AND CENTERED IN GUTTER

GUTTER STAMP TO BE OBTAINED FROM
CITY OF DULUTH BY CONTRACTOR.



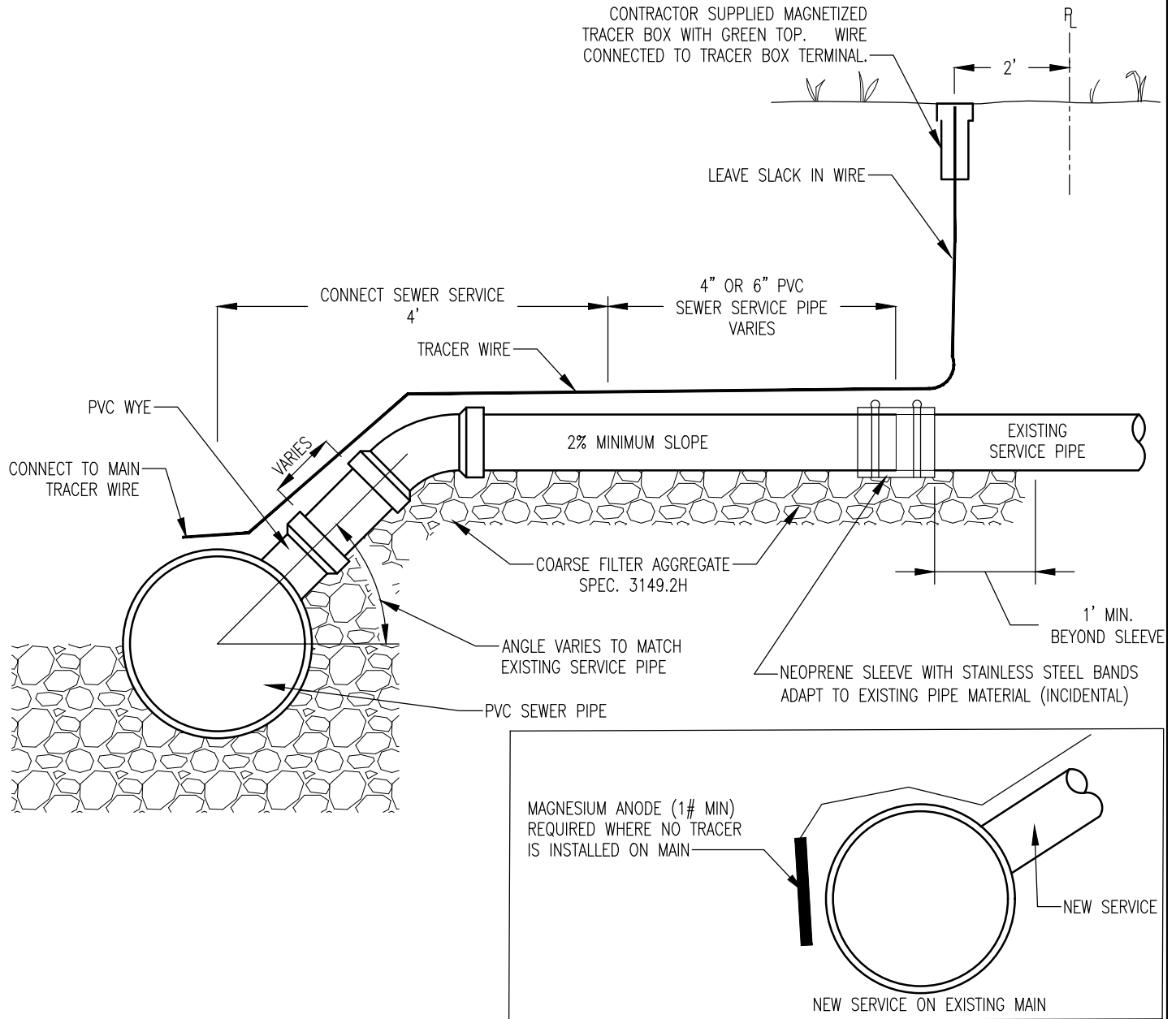
GUTTER STAMP

STRM-7

REVIEWED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES

1. BID ITEM FOR PVC WYE INCLUDES FURNISHING AND INSTALLING WYE IN SEWER MAIN.
2. CONNECT SEWER SERVICE INCLUDES 4" OR 6" PVC SEWER SERVICE PIPE (TO 4' FROM C/L) AND ALL FITTINGS
3. 4" OR 6" PVC SEWER SERVICE PIPE IS INTENDED FOR THE RECONSTRUCTION OF SEWER SERVICES (WHEN FOUND TO BE IN NEED BY THE ENGINEER) COMPLETE IN PLACE FROM 4.0' BEYOND THE C/L OF THE SEWER MAIN TO A POINT DESIGNATED BY THE ENGINEER
4. FOR NEW SERVICES, PIPE TO STOP AT RIGHT OF WAY
5. #12 GAUGE GREEN INSULATED COPPER TRACER WIRE SHALL BE INSTALLED WITH SEWER MAINS AND SERVICES. TRACER WIRE TERMINAL BOXES SHALL BE INSTALLED DIRECTLY ABOVE THE SEWER SERVICE OR AS DETERMINED BY THE ENGINEER
6. FOR SERVICES, TRACER WIRE SHALL RUN FROM THE WYE AND TERMINATE IN A FLUSH MOUNTED TRACER BOX WITH A GREEN CAST IRON LOCKABLE TOP.
7. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

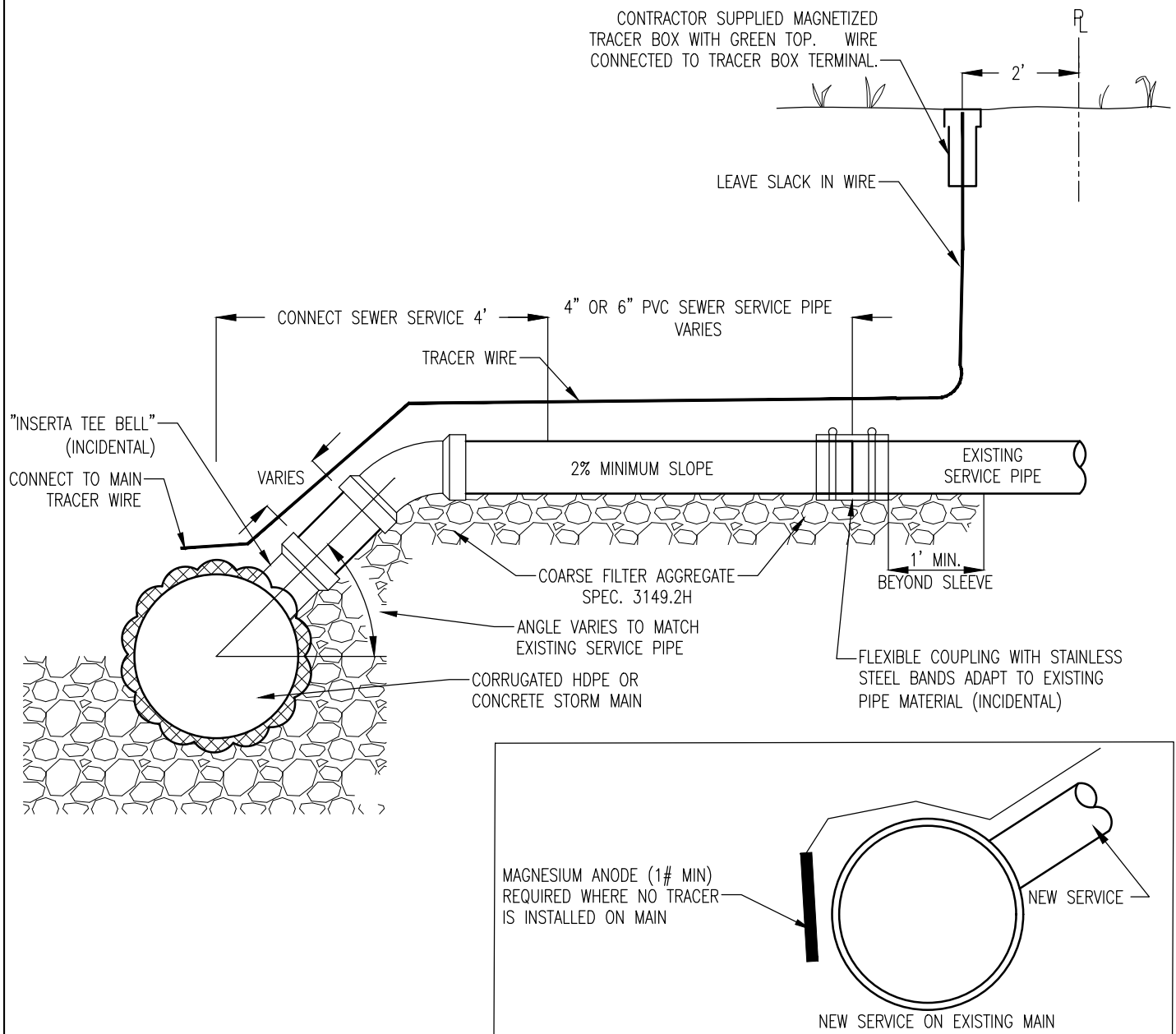
PRIVATE STORM SERVICE – TYPE A

STRM-8

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES

1. PROVIDE AND INSTALL INSERTA TEE (INCIDENTAL).
2. CONNECT SEWER SERVICE INCLUDES 4" OR 6" PVC SEWER SERVICE PIPE (TO 4' FROM C/L) AND ALL FITTINGS
3. 4" OR 6" PVC SEWER SERVICE PIPE IS INTENDED FOR THE RECONSTRUCTION OF SEWER SERVICES (WHEN FOUND TO BE IN NEED BY THE ENGINEER) COMPLETE IN PLACE FROM 4.0' BEYOND THE C/L OF THE SEWER MAIN TO A POINT DESIGNATED BY THE ENGINEER
4. FOR NEW SERVICES, PIPE TO STOP AT RIGHT OF WAY
5. #12 GAUGE GREEN INSULATED COPPER TRACER WIRE SHALL BE INSTALLED WITH SEWER MAINS AND SERVICES. TRACER WIRE TERMINAL BOXES SHALL BE INSTALLED DIRECTLY ABOVE THE SEWER SERVICE OR AS DETERMINED BY THE ENGINEER
6. FOR SERVICES, TRACER WIRE SHALL RUN FROM THE WYE AND TERMINATE IN A FLUSH MOUNTED TRACER BOX WITH A GREEN CAST IRON LOCKABLE TOP.
7. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

PRIVATE STORM SERVICE – TYPE B

STRM-9

REVIEWED/APPROVED 04/05/2019

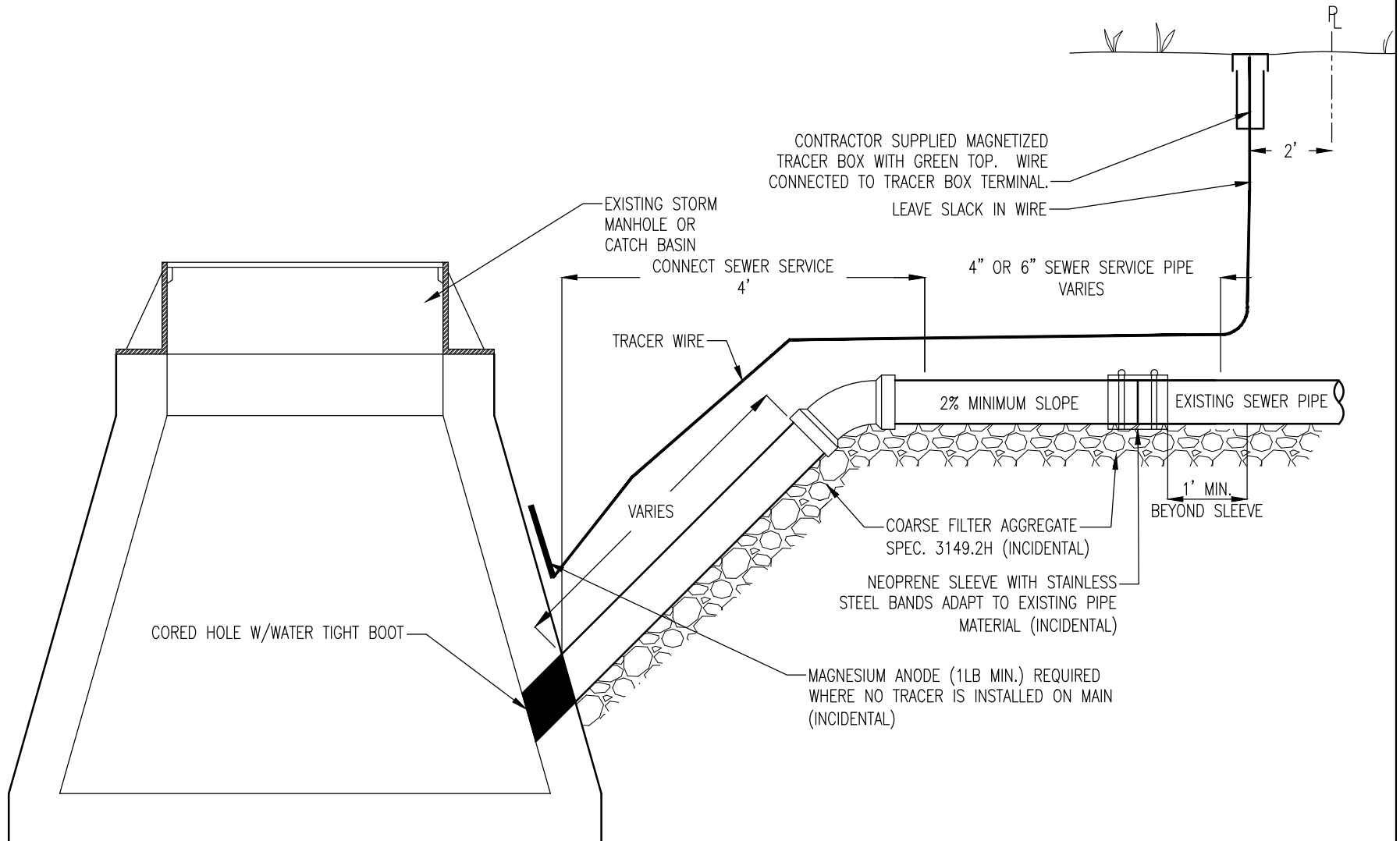
CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

PRIVATE STORM SERVICE – TYPE C



NOTES

1. CONNECT SEWER SERVICE INCLUDES 4" OR 6" PVC SEWER SERVICE PIPE (TO 4' FROM STRUCTURE) AND ALL FITTINGS
2. 4" & 6" PVC SEWER SERVICE PIPE IS INTENDED FOR THE RECONSTRUCTION OF SEWER SERVICES (WHEN FOUND TO BE IN NEED BY THE ENGINEER) COMPLETE IN PLACE FROM 4.0' BEYOND THE STRUCTURE OF THE SEWER MAIN TO A POINT DESIGNATED BY THE ENGINEER
3. FOR NEW SERVICES, PIPE TO STOP AT RIGHT OF WAY
4. #12 GAUGE GREEN INSULATED COPPER TRACER WIRE SHALL BE INSTALLED WITH SEWER SERVICES. TRACER WIRE TERMINAL BOXES SHALL BE INSTALLED DIRECTLY ABOVE THE SEWER SERVICE OR AS DETERMINED BY THE ENGINEER
5. FOR SERVICES, TRACER WIRE SHALL RUN FROM THE WYE AND TERMINATE IN A FLUSH MOUNTED TRACER BOX WITH A GREEN CAST IRON LOCKABLE TOP.
6. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

STRM-10

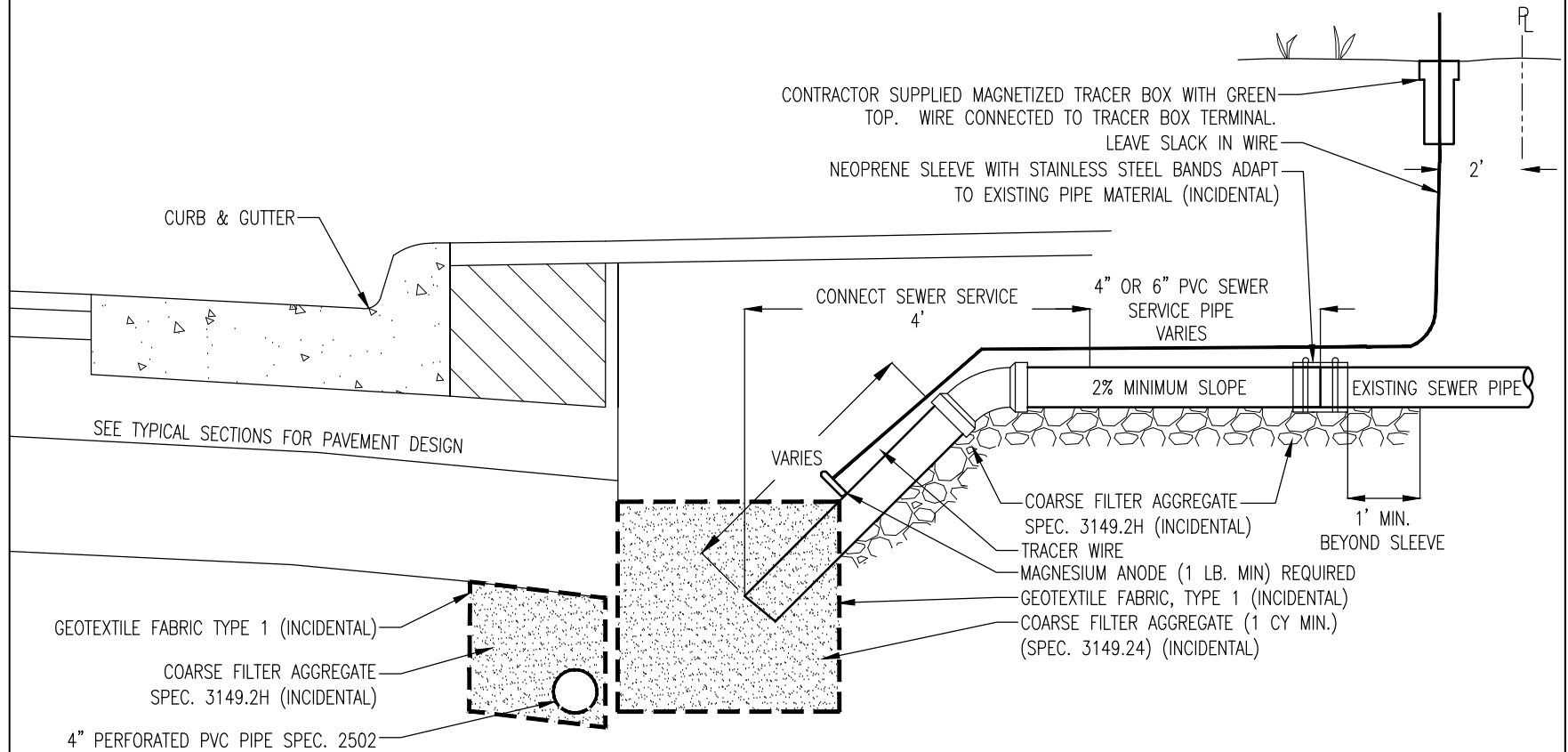
NO SCALE

REVIEWED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

PRIVATE STORM SERVICE - TYPE D

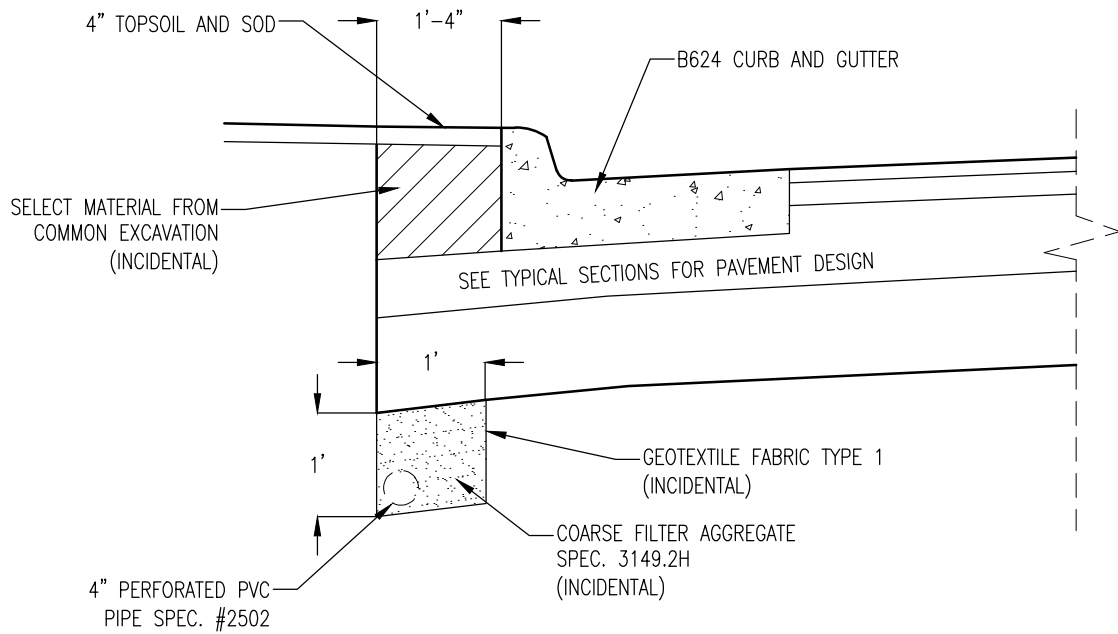
STRM-11



NOTES

1. CONNECT SEWER SERVICE INCLUDES 4" OR 6" PVC SEWER SERVICE PIPE (TO 4' FROM END) AND ALL FITTINGS
2. 4" OR 6" PVC SEWER SERVICE PIPE IS INTENDED FOR THE RECONSTRUCTION OF SEWER SERVICES (WHEN FOUND TO BE IN NEED BY THE ENGINEER) COMPLETE IN PLACE FROM 4.0' BEYOND THE END OF THE SERVICE TO A POINT DESIGNATED BY THE ENGINEER
3. #12 GAUGE GREEN INSULATED COPPER TRACER WIRE SHALL BE INSTALLED WITH SEWER SERVICES. TRACER WIRE TERMINAL BOXES SHALL BE INSTALLED DIRECTLY ABOVE THE SEWER SERVICE OR AS DETERMINED BY THE ENGINEER
4. FOR SERVICES, TRACER WIRE SHALL RUN FROM THE END AND TERMINATE IN A FLUSH MOUNTED TRACER BOX WITH A GREEN CAST IRON LOCKABLE TOP.
5. THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

NO SCALE



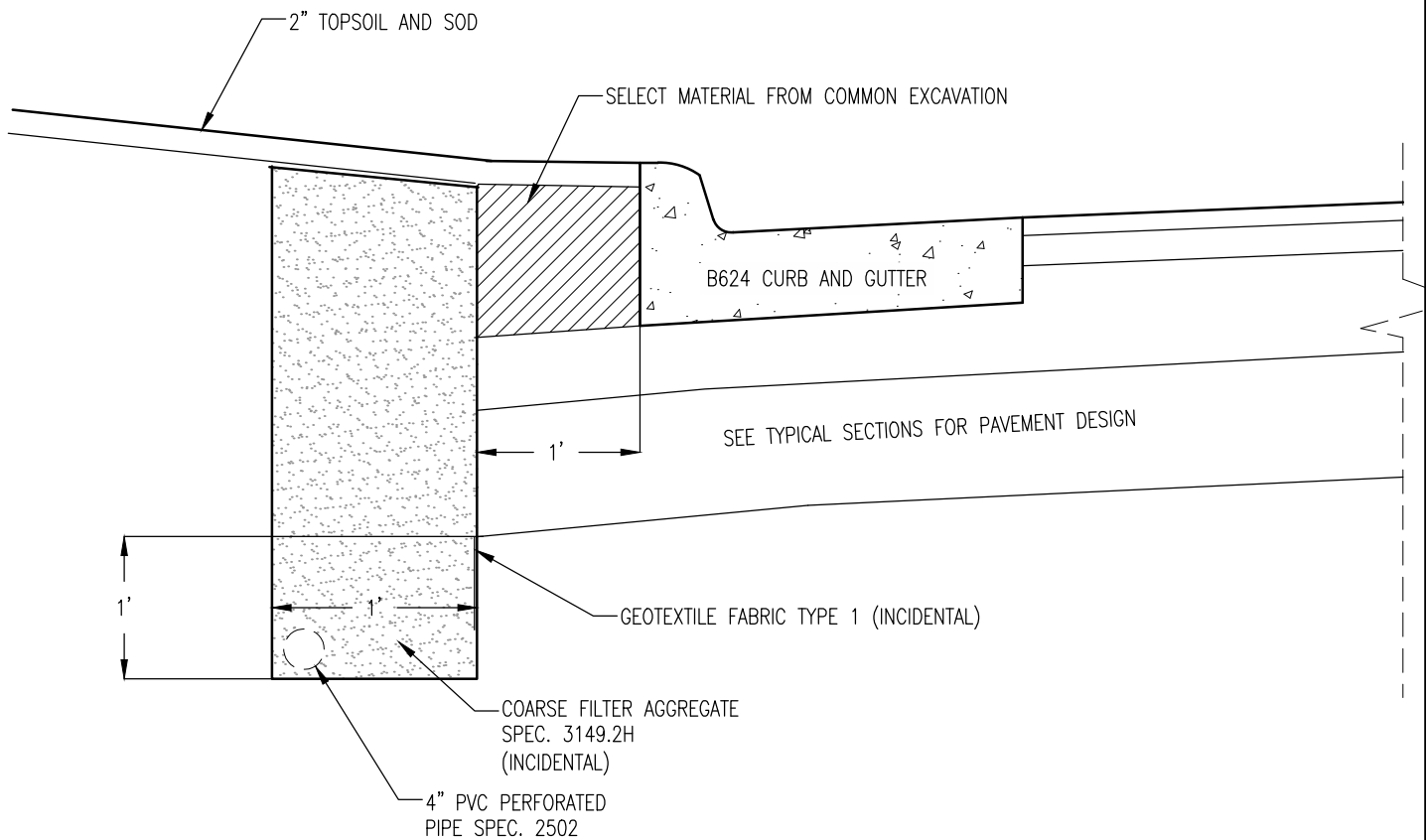
PERFORATED PIPE DETAIL

STR-1

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



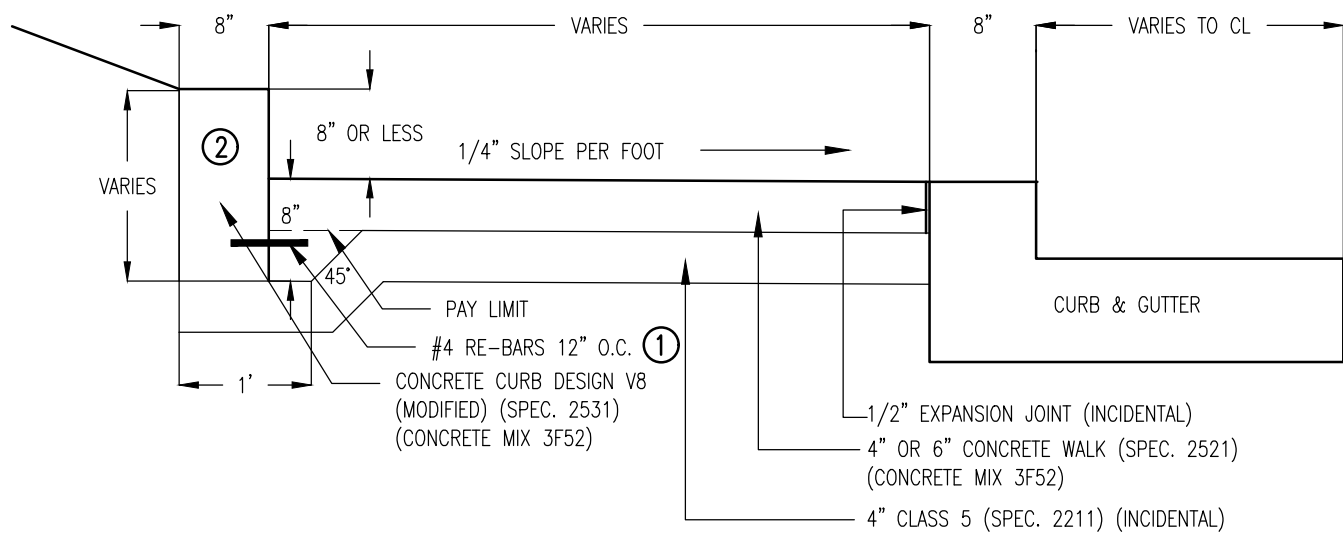
PERFORATED PIPE – SPECIAL

STR-2

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. OPTIONAL REINFORCEMENT TIE BARS (INCIDENTAL) IF CURB IS POURED SEPARATELY FROM SIDEWALK
2. EXACT LOCATION AND ELEVATION OF CONCRETE CURB WILL BE DETERMINED IN THE FIELD BY THE ENGINEER

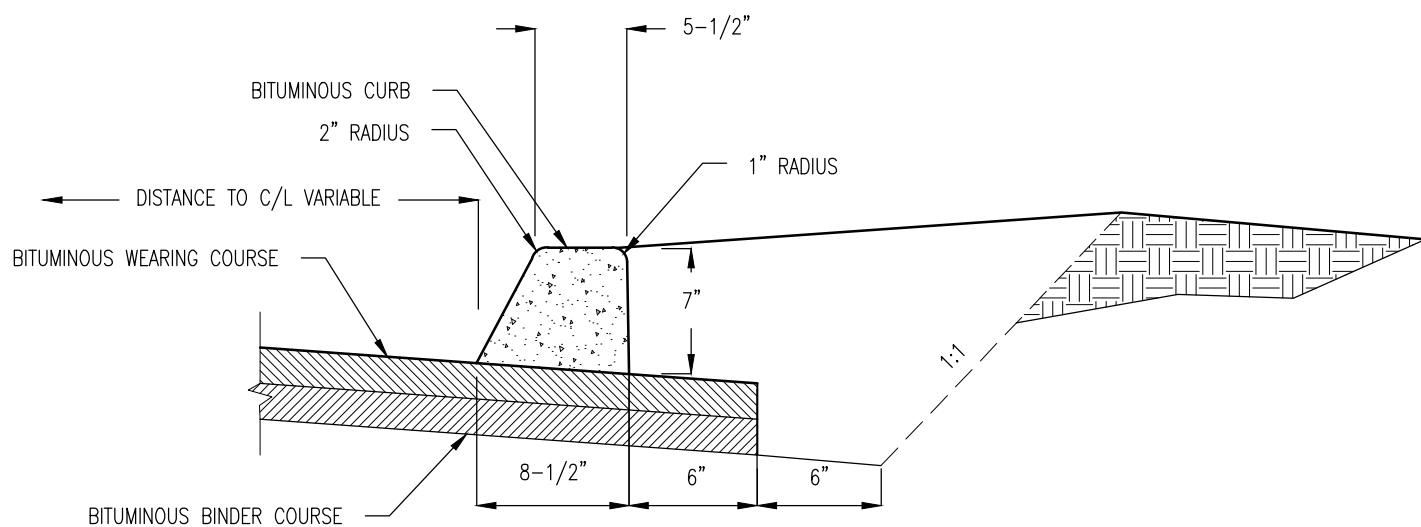
4" OR 6" CONCRETE WALK WITH CONCRETE CURB DESIGN V8 (MODIFIED)

STR-3

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



VOLUME OF CURB
0.338 CU. FT. PER LIN. FT.

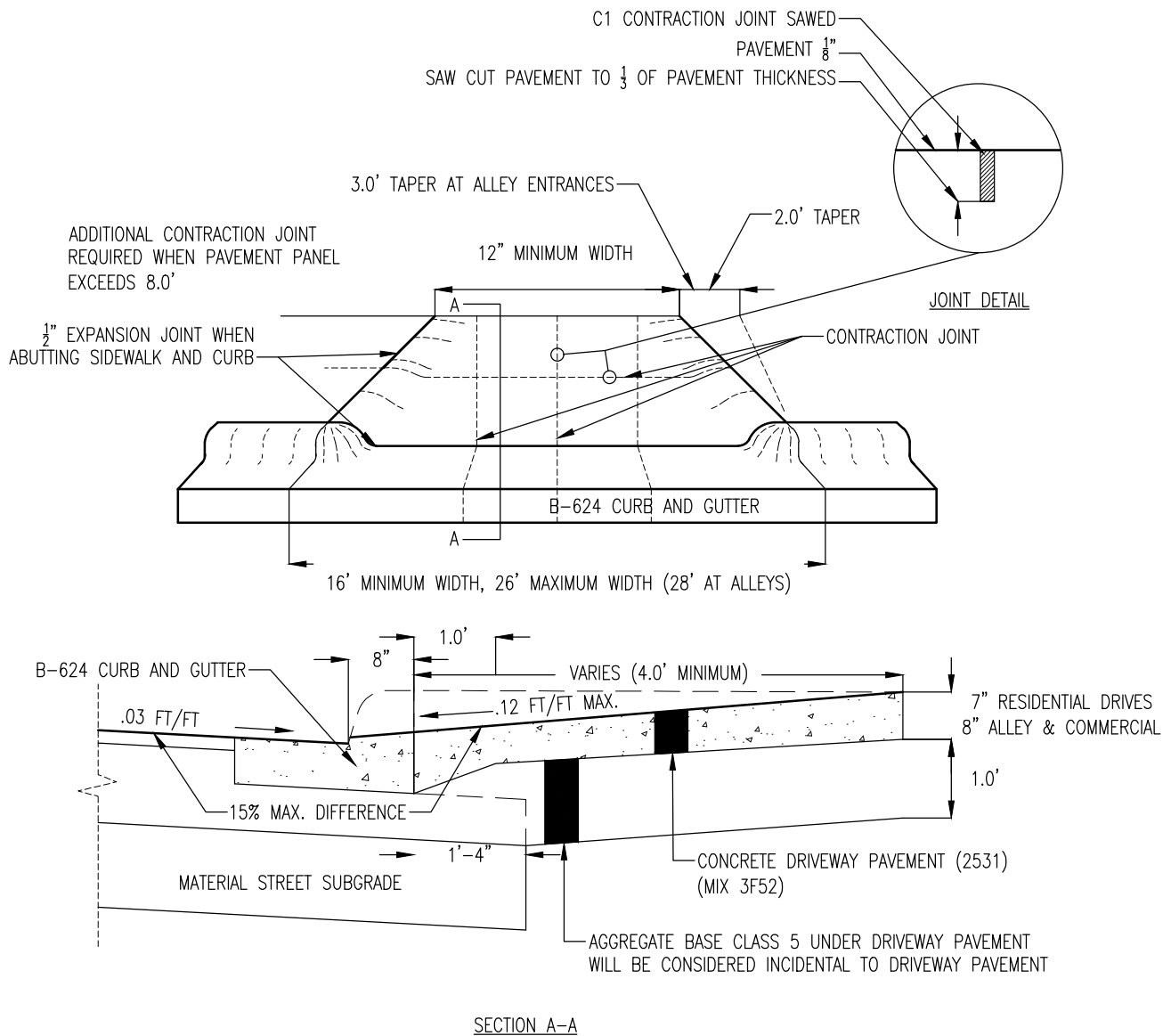
BITUMINOUS CURB

STR-4

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

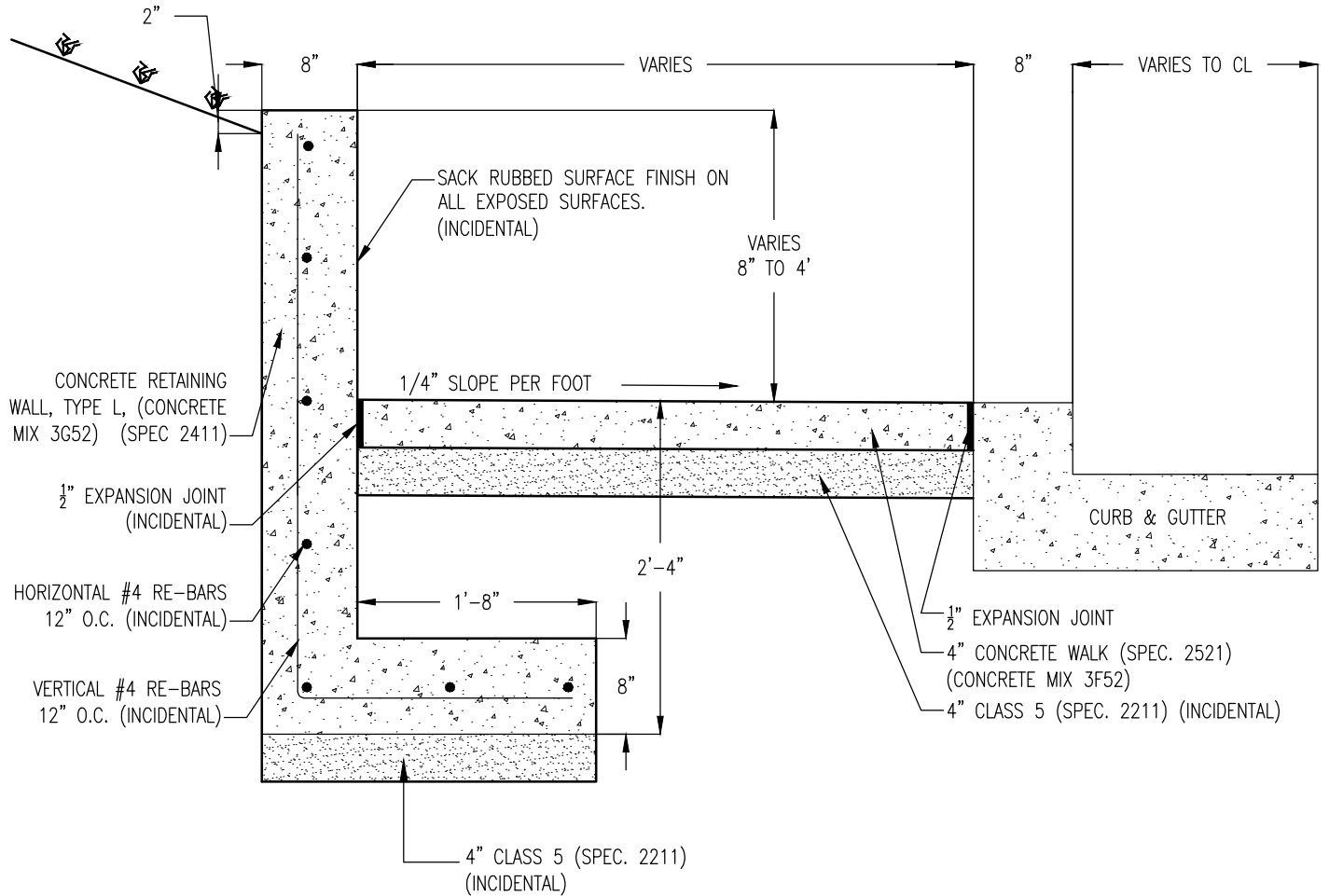


NOTES:

1. WHERE THERE IS NO SIDEWALK OR THERE IS A GRASS BOULEVARD BETWEEN THE SIDEWALK AND THE BACK OF CURB THE CREST OF THE DRIVEWAY MUST BE AT LEAST 6" ABOVE GUTTER TO CONTAIN RUNOFF.
2. WHERE THERE IS SIDEWALK DIRECTLY BEHIND THE CURB, DRIVEWAY PROFILE SLOPE SHALL BE FLATTENED TO MEET ADA ACCESSIBLE ROUTE STANDARDS

DRIVEWAY & ALLEY ENTRANCES		STR-5
REVISED/APPROVED 04/05/2019	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE

EXACT LOCATION AND ELEVATION OF RETAINING WALL WILL
BE DETERMINED IN THE FIELD BY THE ENGINEER



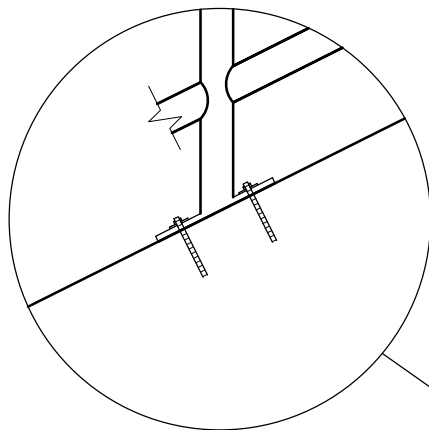
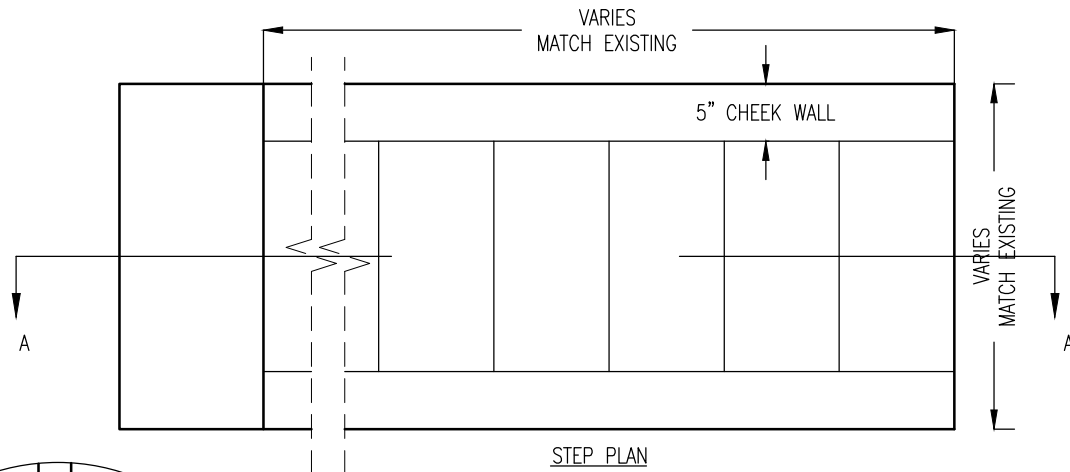
CONCRETE RETAINING WALL, TYPE L

STR-6

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



ALTERNATE METHOD OF ATTACHMENT:
POST SET IN SLEEVE, PLATE 8400E

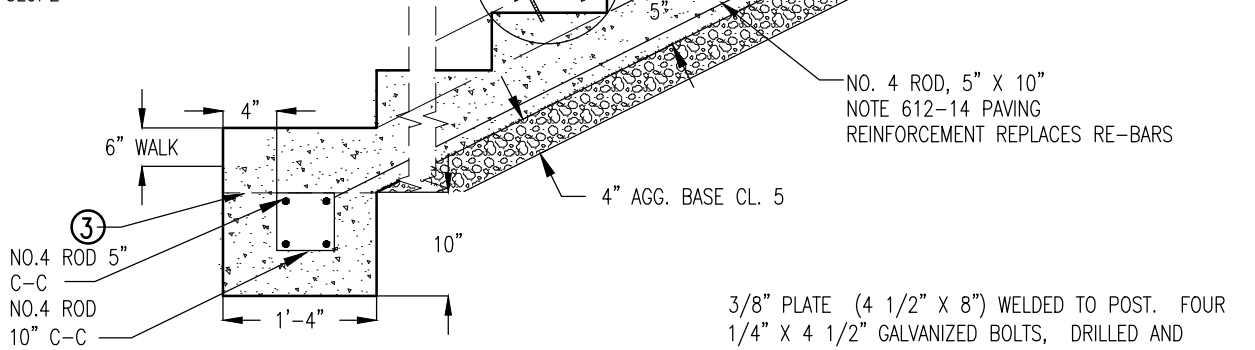
PIPE RAILING PER
STD. PLATE 8400E

TOP OF RAISED
CHEEK WALL

TOP HANDRAIL SHALL BE
1-1/2" TO 2" DIAMETER

TOP OF RAILING
SHALL BE 34" TO 38"
ABOVE TOP OF STEP

TREAD + RISER = 18" RISE WILL
BE 4-1/2" MIN., 7" MAX. TREAD
1% SLOPE



SECTION A-A

NOTES:

1. 5" WIDE RAISED OR LOWERED CHEEK WALLS TO BE DETERMINED IN FIELD BY ENGINEER.
2. RAILINGS WILL BE REQUIRED WHERE MORE THAN THREE STEPS ARE NEEDED. RAILINGS TO BE PAINTED WITH BLACK PAINT PER CITY STANDARD SPEC. 2402
3. THE CONCRETE LUG ANCHOR MAY NOT BE NEEDED FOR 2 STEPS OR LESS.
4. INCLUDES: ALL EXCAVATION (EXCEPT ROCK EXC.), REMOVAL OF EXISTING STEPS, FORMING, CLASS 5, REINFORCING BAR, BACKFILL, AND CONCRETE (MIX 3G52),

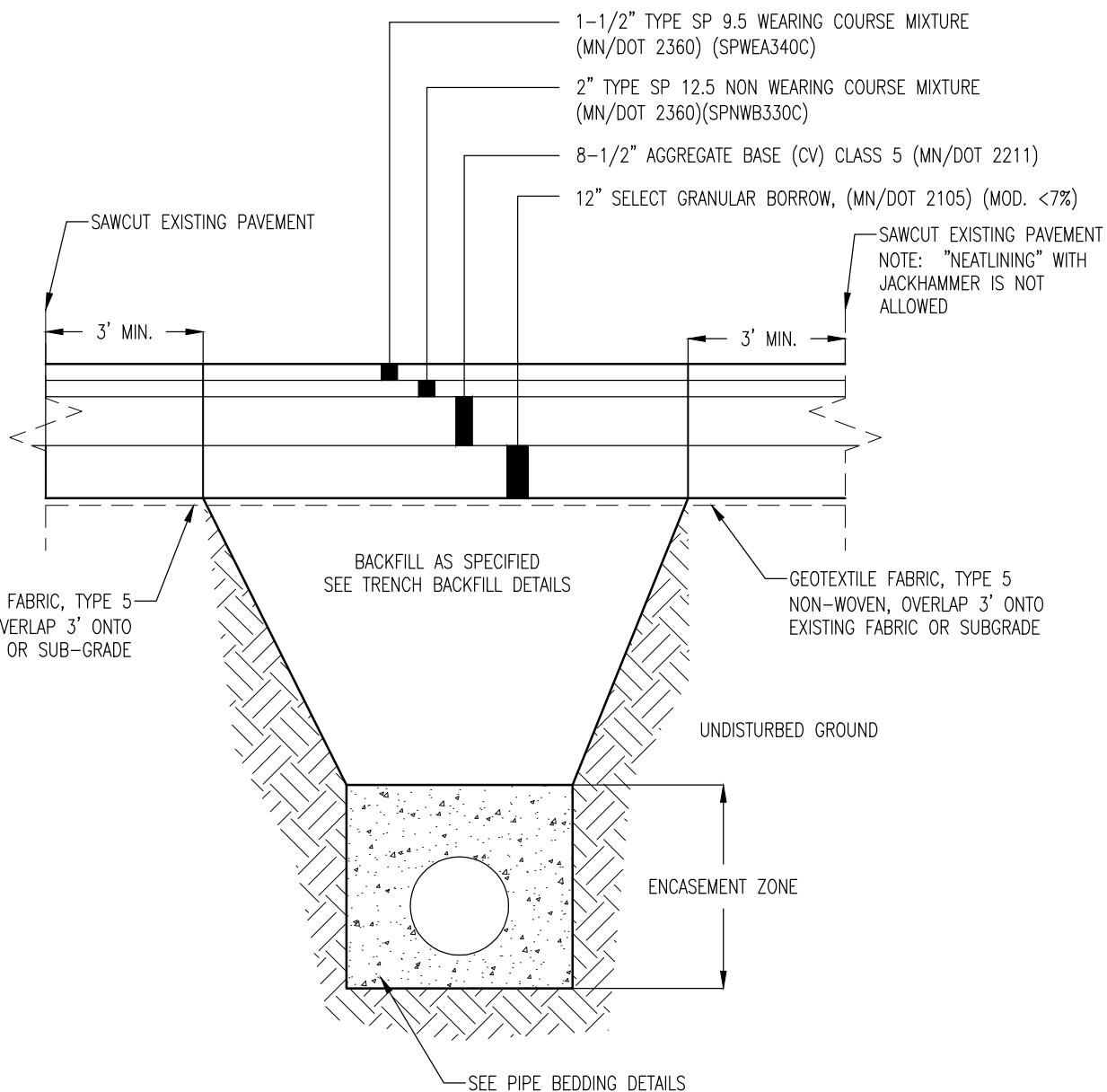
CONCRETE STEPS

STR-7

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



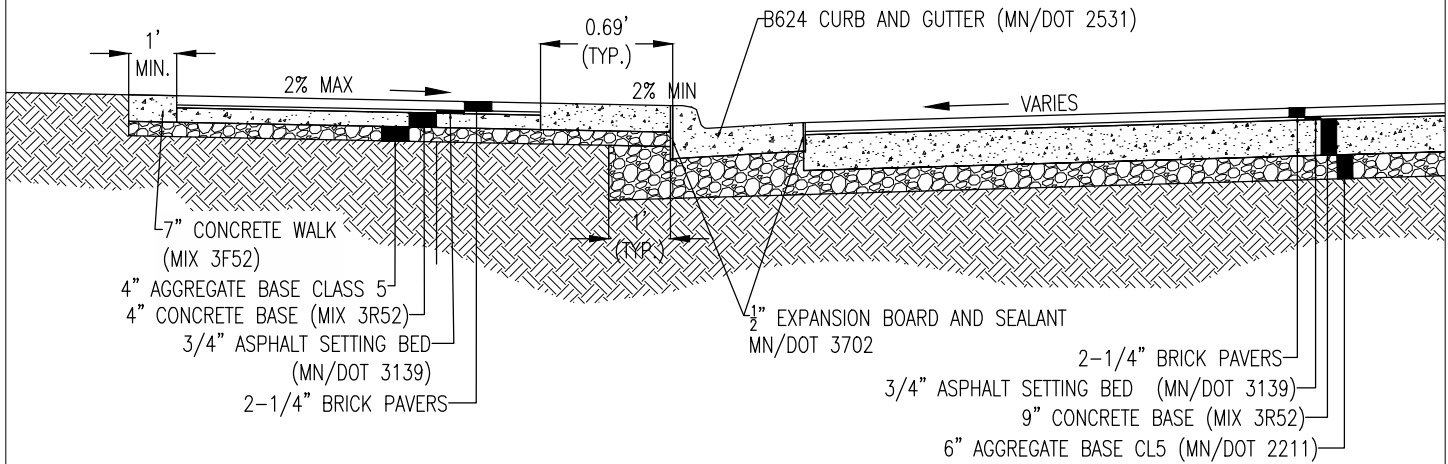
STREET RESTORATION OVER TRENCH

STR-8

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. REFER TO 2540 BRICK PAVEMENT RESTORATION IN THE CITY OF DULUTH CONSTRUCTION STANDARDS
2. DRILL AND GROUT 1" DIA. DOWEL BARS (24" LENGTH) 16" O.C. INTO ADJACENT EXISTING CONCRETE BASE
3. ASPHALT SETTING BED MATERIALS SHALL MEET GRADATION "A" OF TABLE 3139-2 OF MN/DOT 3139
4. CONCRETE MIX 3F52 (SIDEWALK) OR MIX 3R52 (CONCRETE BASE) SHALL MEET THE PROVISIONS OF MN/DOT 2301 AND MN/DOT 2461
5. BRICK PAVERS (4" X 8" X 2-1/4") SHALL MEET ASTM C902-79A, EXCEPT AS MODIFIED IN THE CITY OF DULUTH CONSTRUCTION STANDARDS. BRICK COLOR AND TEXTURE SHALL MATCH EXISTING OR AS APPROVED BY ENGINEER.

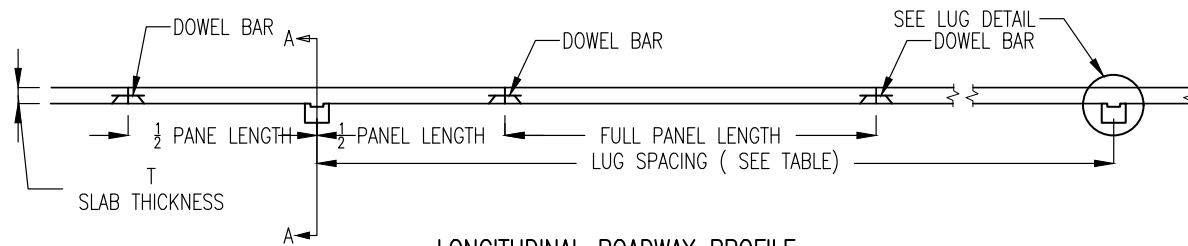
BRICK PAVEMENT RESTORATION

STR-9

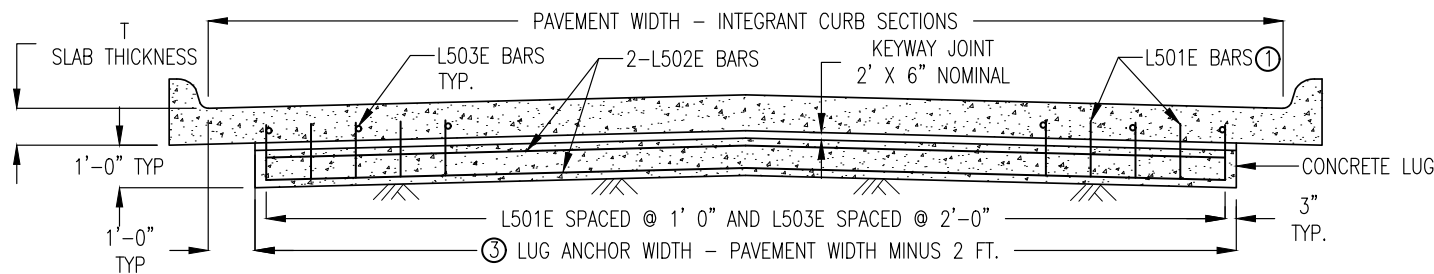
REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

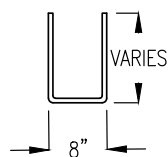
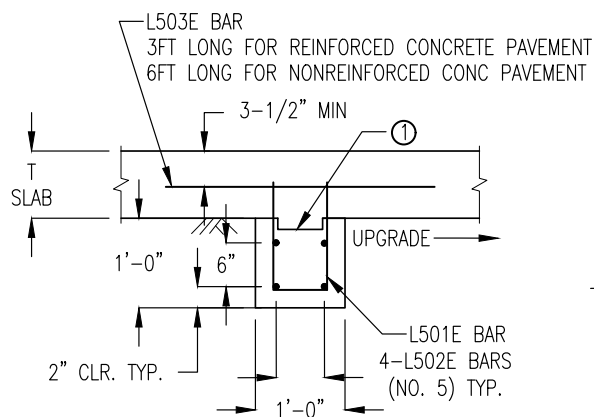
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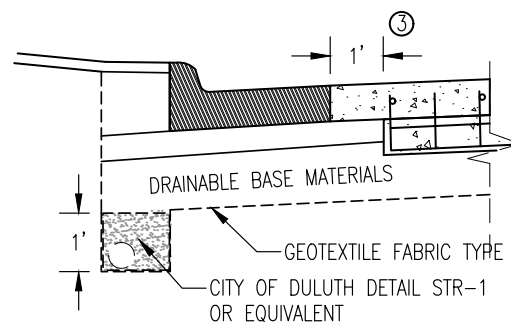
LONGITUDINAL ROADWAY PROFILE



SECTION A-A



L501E



STANDARD CURB & GUTTER

LUG ANCHOR SPACING TABLE

ROADWAY GRADE	LUG ANCHOR SPACING	
	REINFORCED PAVEMENTS	UNREINFORCED PAVEMENTS*
OVER 3%	162 FT	153 FT
OVER 3-1/4%	135 FT	140 FT
OVER 3-1/2%	108 FT	111 FT
OVER 3-3/4%	81 FT	91 FT
OVER 4%	81 FT	78 FT
OVER 4-1/4%	54 FT	62 FT
OVER 4-1/2%	54 FT	45 FT

* ADJUST TO FALL IN THE MIDDLE OF THE CONCRETE PANEL

SEE SPECIAL PROVISIONS FOR INSTALLATION AND MATERIAL DETAILS.

GENERAL NOTES

1. NO LUG DRAIN REQUIRED ON STREET SECTIONS CONSTRUCTED WITH A DRAINABLE BASE AND PERFORATED EDGE DRAIN SYSTEM.
2. FINAL GRADING OPERATIONS SHALL BE COMPLETED PRIOR TO EXCAVATING FOR LUG ANCHORS. ANY OVER TRENCHING SHALL BE FILLED WITH CONCRETE.
3. LUG ANCHORS SHALL BE CONSTRUCTED 2 DAYS PRIOR TO PAVEMENT CONSTRUCTION, WITH CONCRETE MIX 3G52 HE.
4. ALL REINFORCEMENT TO BE EPOXY COATED NO. 5 DEFORMED BARS AS PER MN/DOT SPEC. 3301, GRADE 60 AND TO HAVE A MINIMUM OF 2" COVER EXCEPT AS NOTED.

NOTES

- ① KEYWAY JOINT APPROXIMATELY 5-1/2" X 1-1/2", USE NOMINAL 2" X 6" PLANK TO FORM KEYWAY.
- ② CONTRACTOR MAY BEND OR USE THREADED CONNECTOR ON L501E BARS AND / OR MODIFY KEYWAY TO FACILITATE FINE GRADING UPON APPROVAL BY THE ENGINEER.
- ③ LUG ANCHOR WIDTH SHALL BE DETERMINED FROM FACE OF CURB MEASURE FOR INTEGRANT CURB DESIGNS, OR EDGE OF PAVEMENT FOR NON-INTEGRANT CURB AND GUTTER DESIGNS.

LUG ANCHOR - CONCRETE PAVEMENT

STR-10

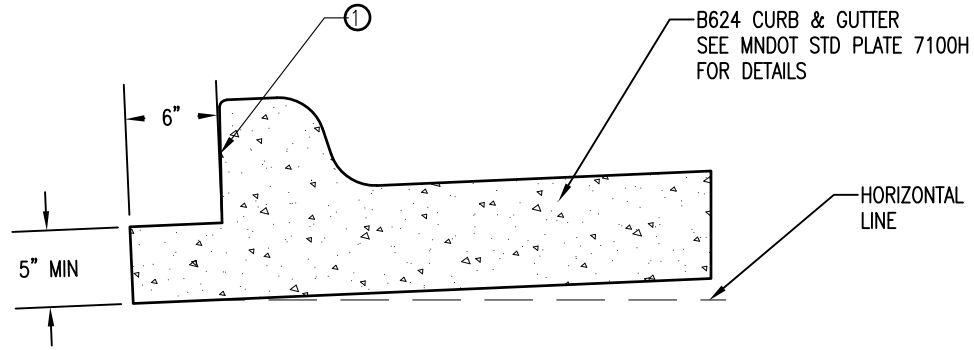
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

SILL CURB DETAIL

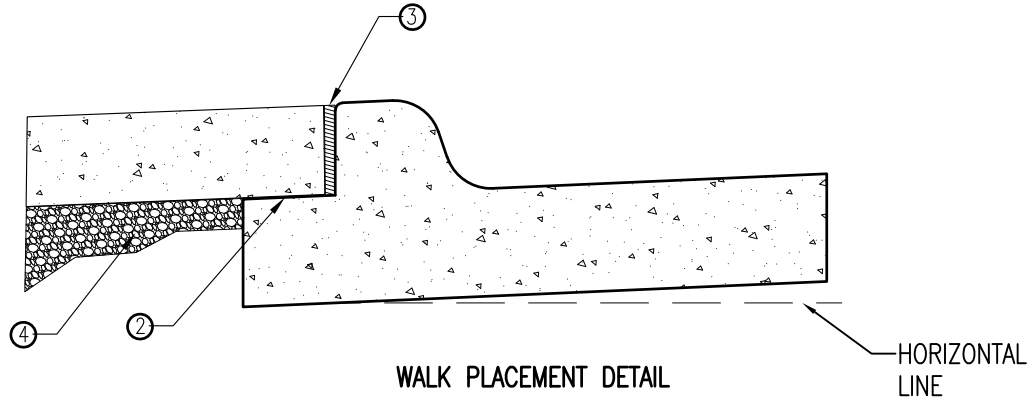
FOR 6 OR 8 INCH CONCRETE WALKS



SILL SHALL BE INTEGRAL TO THE CURB & GUTTER

NOTES

- ① DIMENSION TO BE THE SAME AS SIDEWALK. (MIN 6")
- ② PLACE BOND BREAKER BETWEEN WALK AND TOP OF SILL
- ③ 1/2" PREFORMED JOINT FILL MNDOT SPEC. 3702
- ④ COMPACTED AGGREGATE BASE CLASS 5 MNDOT SPEC 2211
- ⑤ INCIDENTAL TO SIDEWALK CONSTRUCTION.



WALK PLACEMENT DETAIL

DESIGN TYPE	CONCRETE	
	CU YDS. PER LINEAL FOOT	LINEAL FT. PER CU YD
B624 - 6" WALK	0.0793	12.61
B624 - 8" WALK	0.0756	13.28

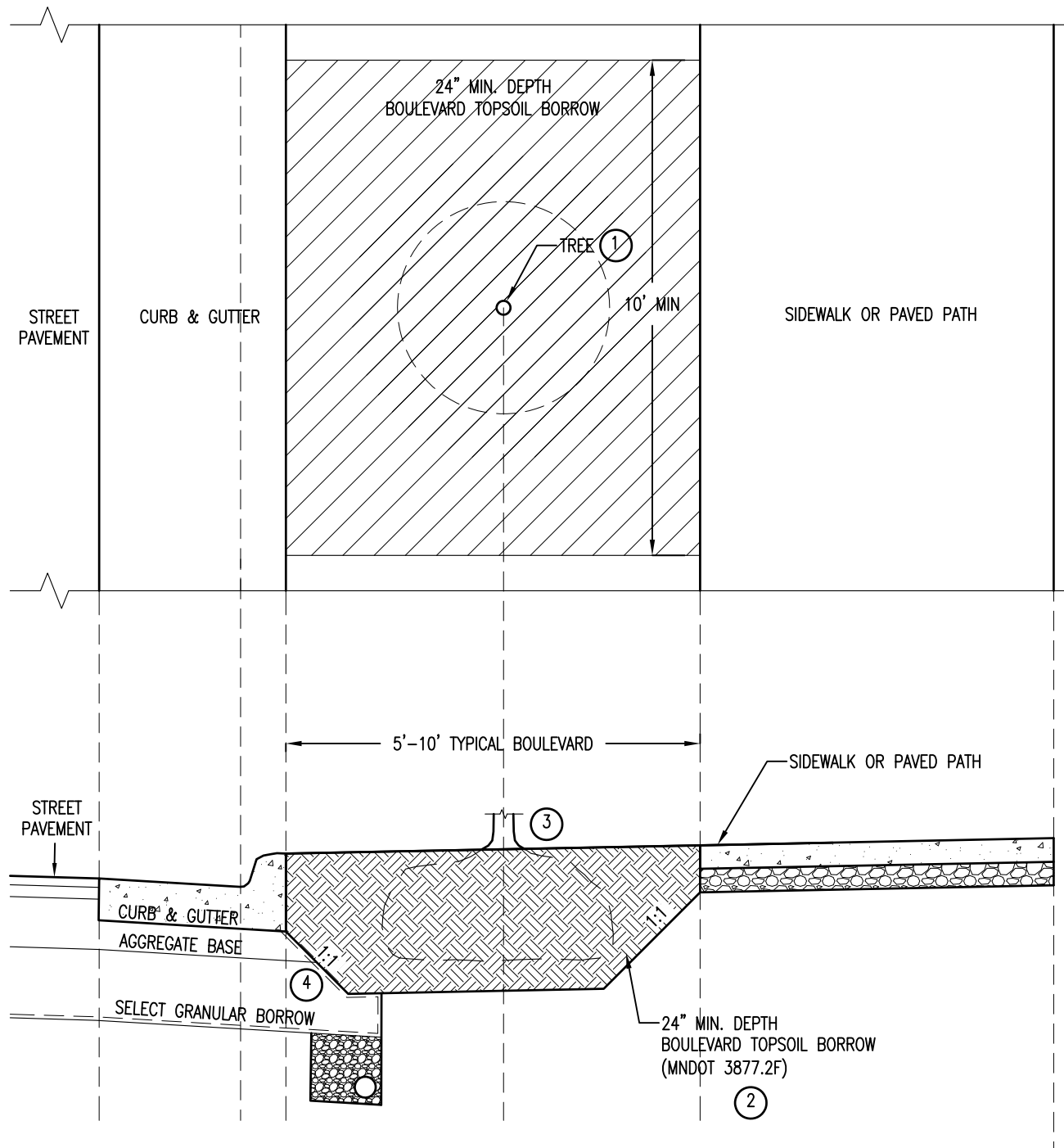
SILL CURB TYPE B624 (SPECIAL)

STR-11

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

- ① TREE SPECIES AND LOCATIONS SHALL BE IN ACCORDANCE WITH SECTION 2571 OF THE CONSTRUCTION STANDARDS.
- ② SUBMIT BOULEVARD TOPSOIL BORROW DESIGN MIX AT LEAST 3 WEEKS PRIOR TO USE.
- ③ DEPTH OF TREE PLANTING PER MN/DOT 2571 AND (ICAMMLP)
- ④ EXTEND GEOTEXTILE SEPARATION FABRIC BETWEEN PLANTING ZONE AND STREET SUBBASE/BASE.

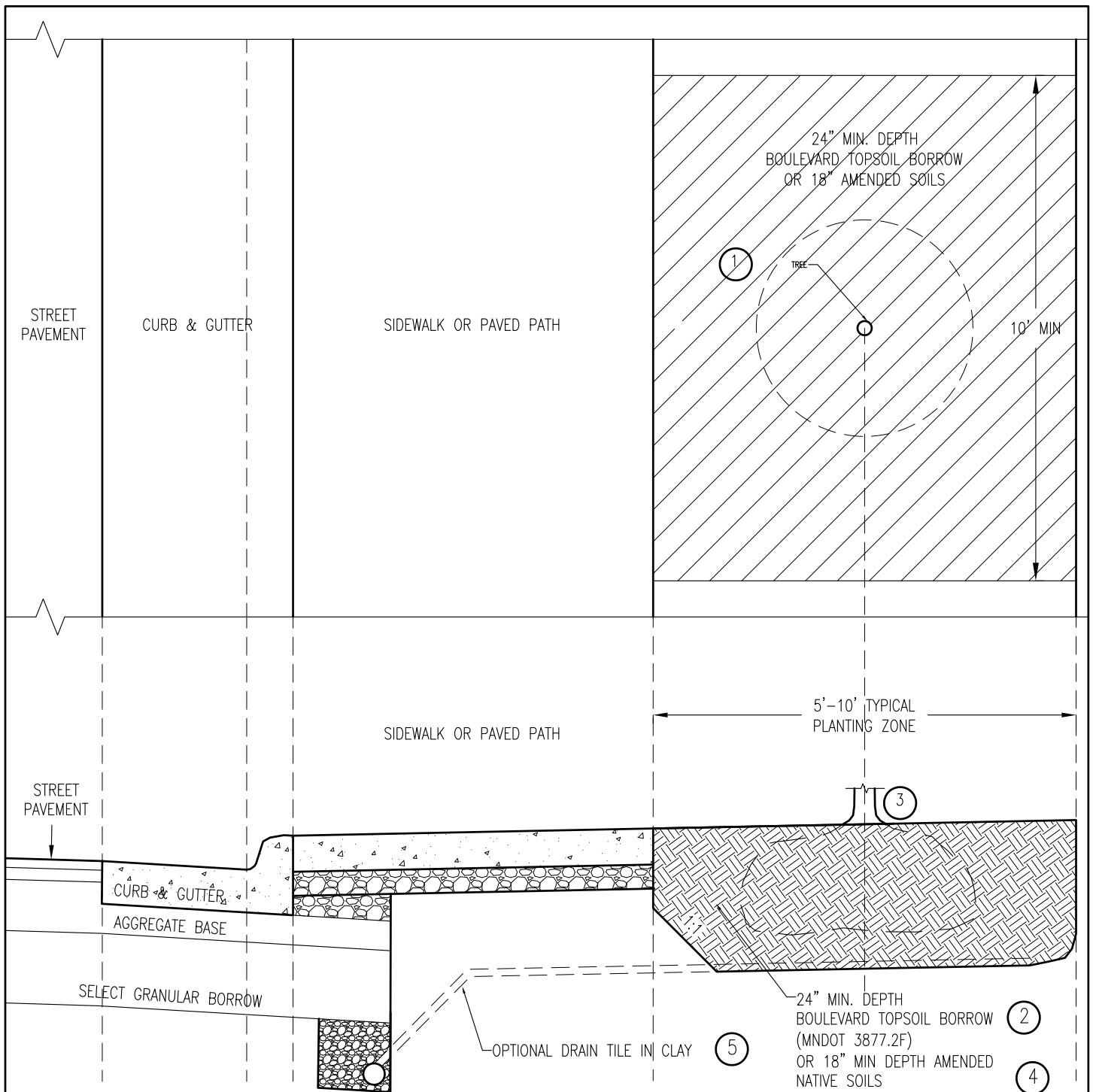
STREET TREE PLANTING ZONE SOIL TREATMENT – BLVD

STR-12

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

- ① TREE SPECIES AND LOCATIONS SHALL BE IN ACCORDANCE WITH SECTION 2571 OF THE CONSTRUCTION STANDARDS.
- ② SUBMIT BOULEVARD TOPSOIL BORROW DESIGN MIX AT LEAST 3 WEEKS PRIOR TO USE.
- ③ DEPT OF TREE PLANTING PER MN/DOT 2571 AND (ICAMMLP)
- ④ SUBMIT SOIL AMENDMENT DESIGN MIX AT LEAST 4 WEEKS PRIOR TO USE.
- ⑤ CONNECT OPTIONAL PLANTING ZONE DRAIN TILE TO STREET PIPE UNDERDRAIN OR NEARBY DRAINAGE STRUCTURE AS DIRECTED BY ENGINEER.

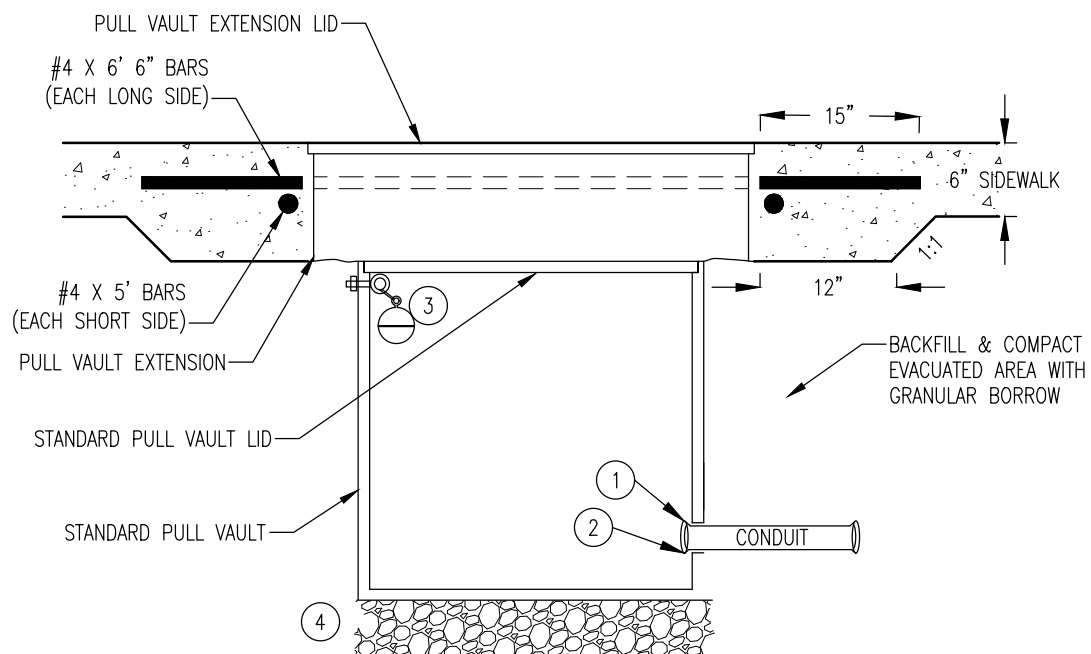
STREET TREE PLANTING ZONE SOIL TREATMENT-BEHIND SIDEWALK

STR-13

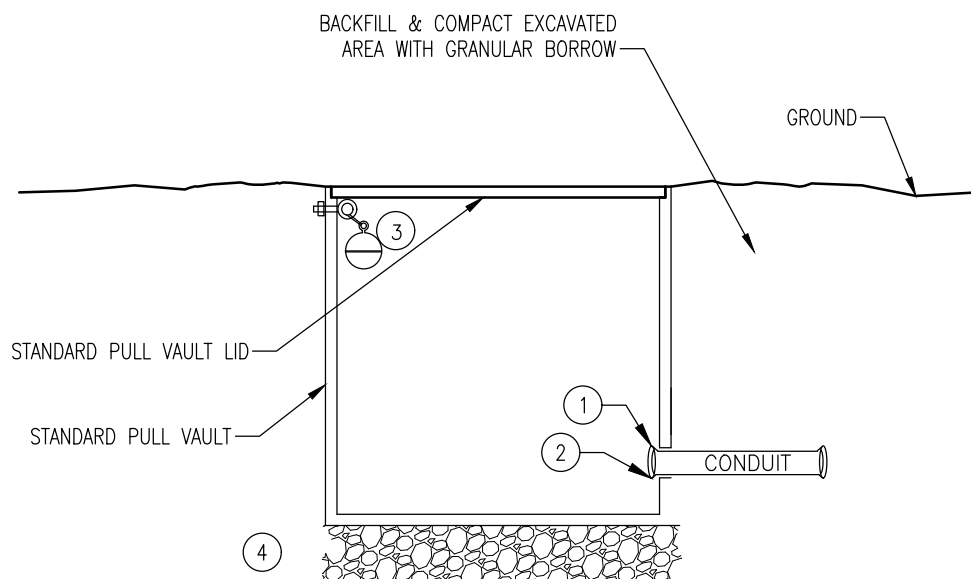
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



HAND HOLE VAULT INSTALLATION
(SIDEWALK)



VAULT INSTALLATION (GROUND)
(CITY OWNED)

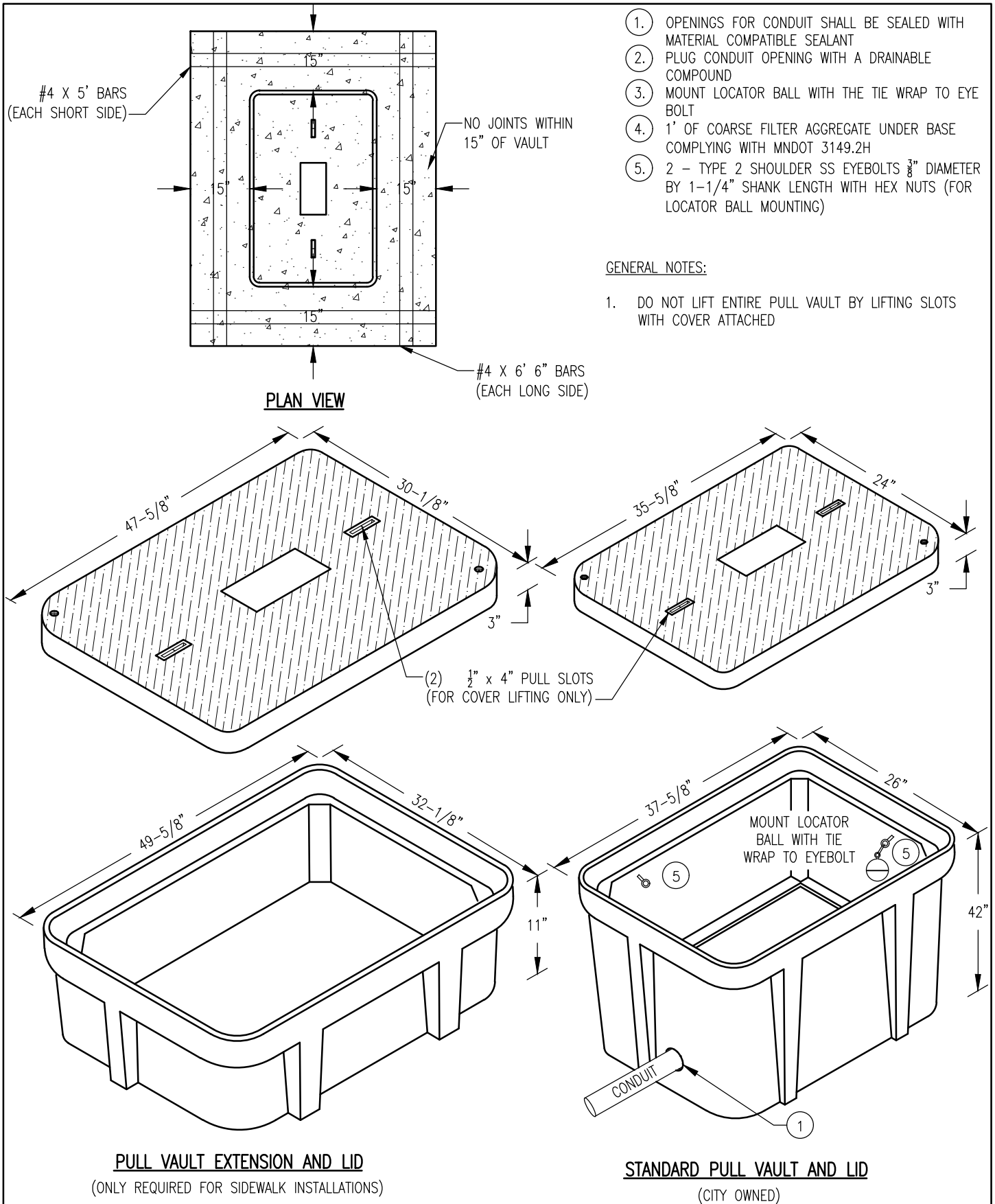
PULL VAULT INSTALLATION A

STR-14A

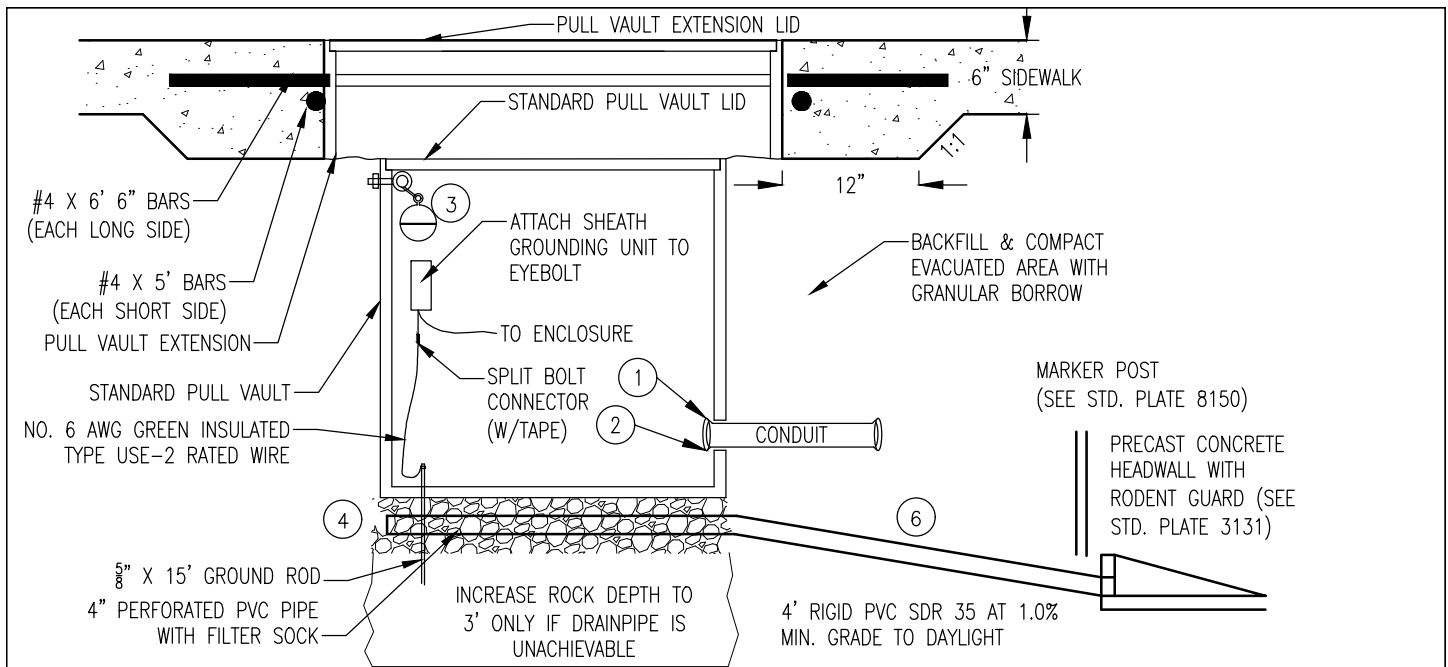
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

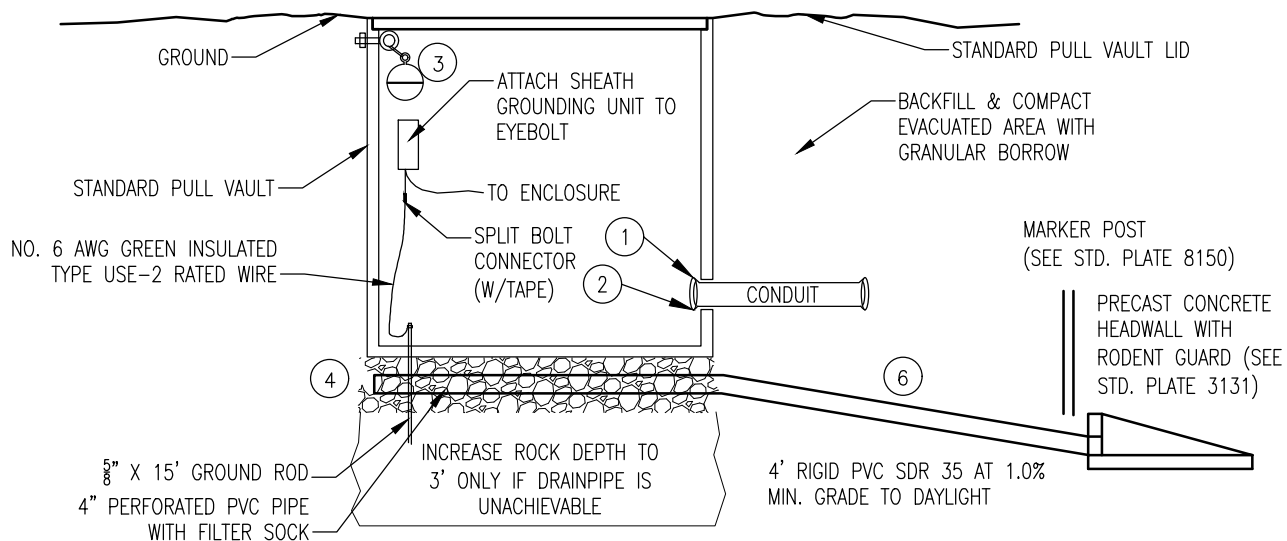
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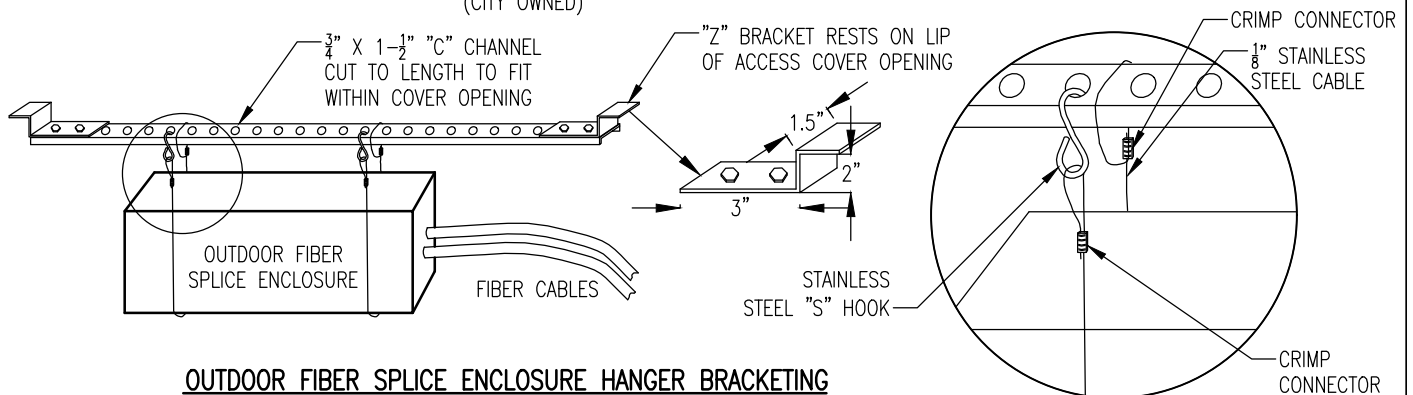
PULL VAULT INSTALLATION B		STR-14B
REVISED/APPROVED 04/05/2019	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



PULL/SPLICE VAULT INSTALLATION
 (SIDEWALK)



VAULT INSTALLATION (GROUND)
 (CITY OWNED)



OUTDOOR FIBER SPLICING ENCLOSURE HANGER BRACKETING

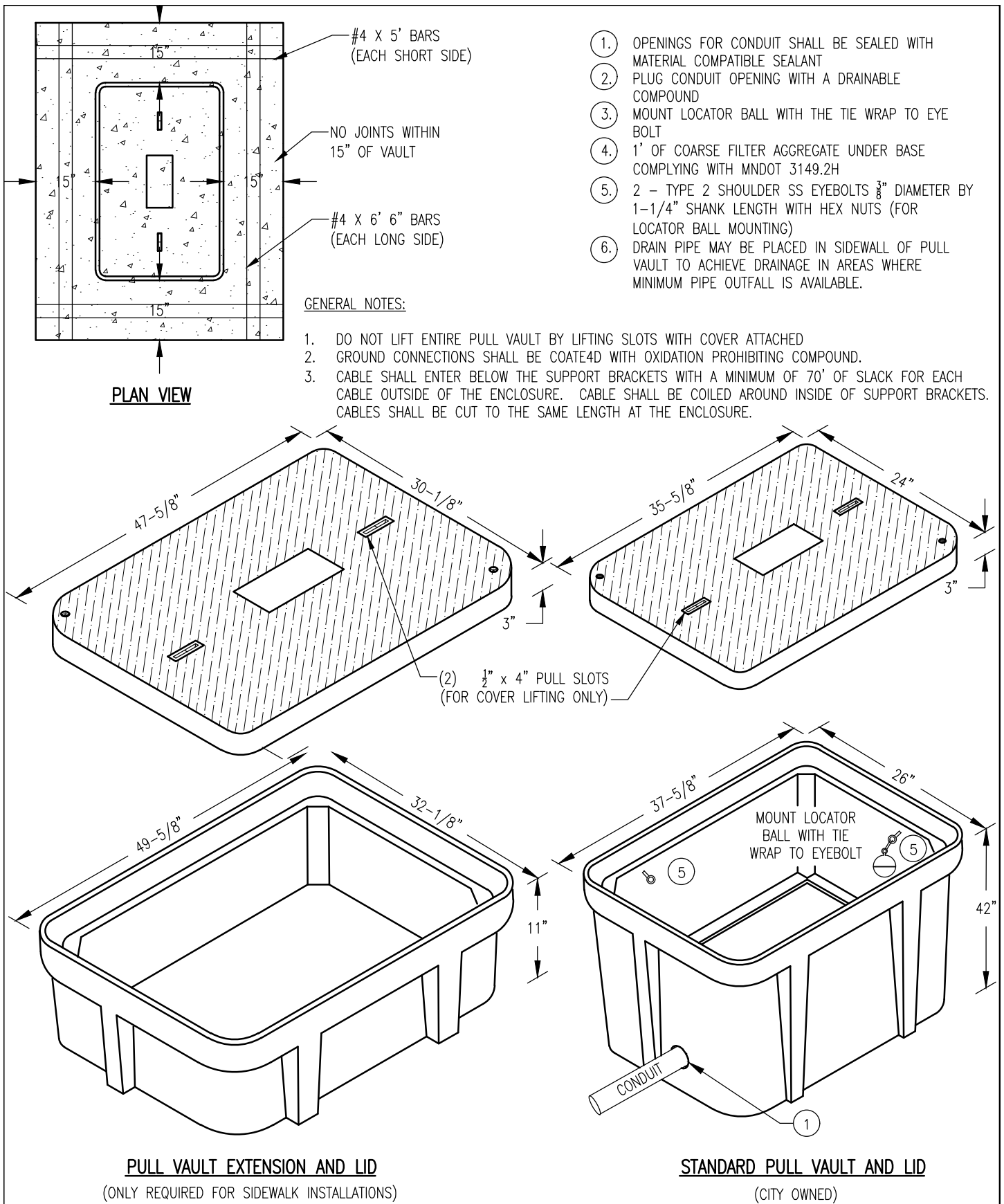
PULL VAULT INSTALLATION C

STR-14C

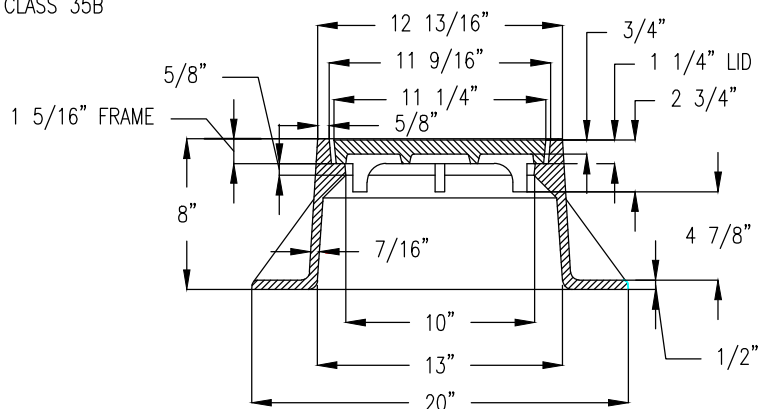
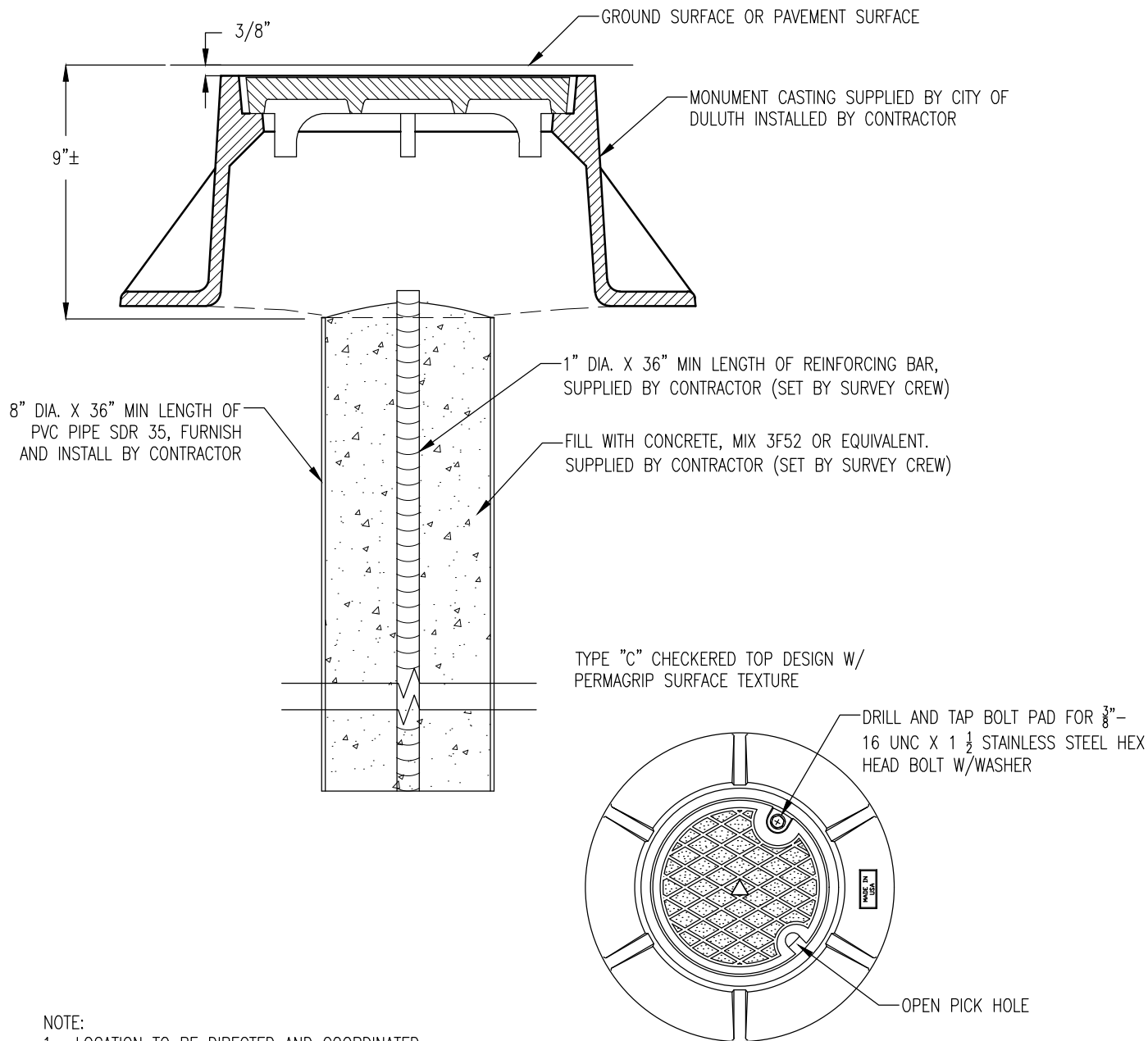
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
 DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



PULL VAULT INSTALLATION D		STR-14D
REVISED/APPROVED 04/05/2019	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



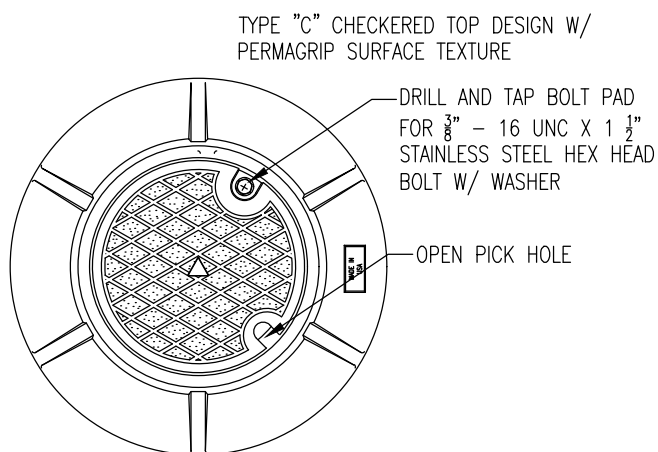
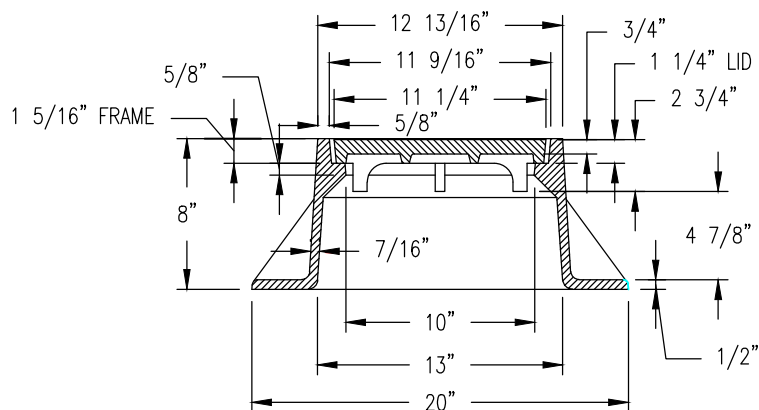
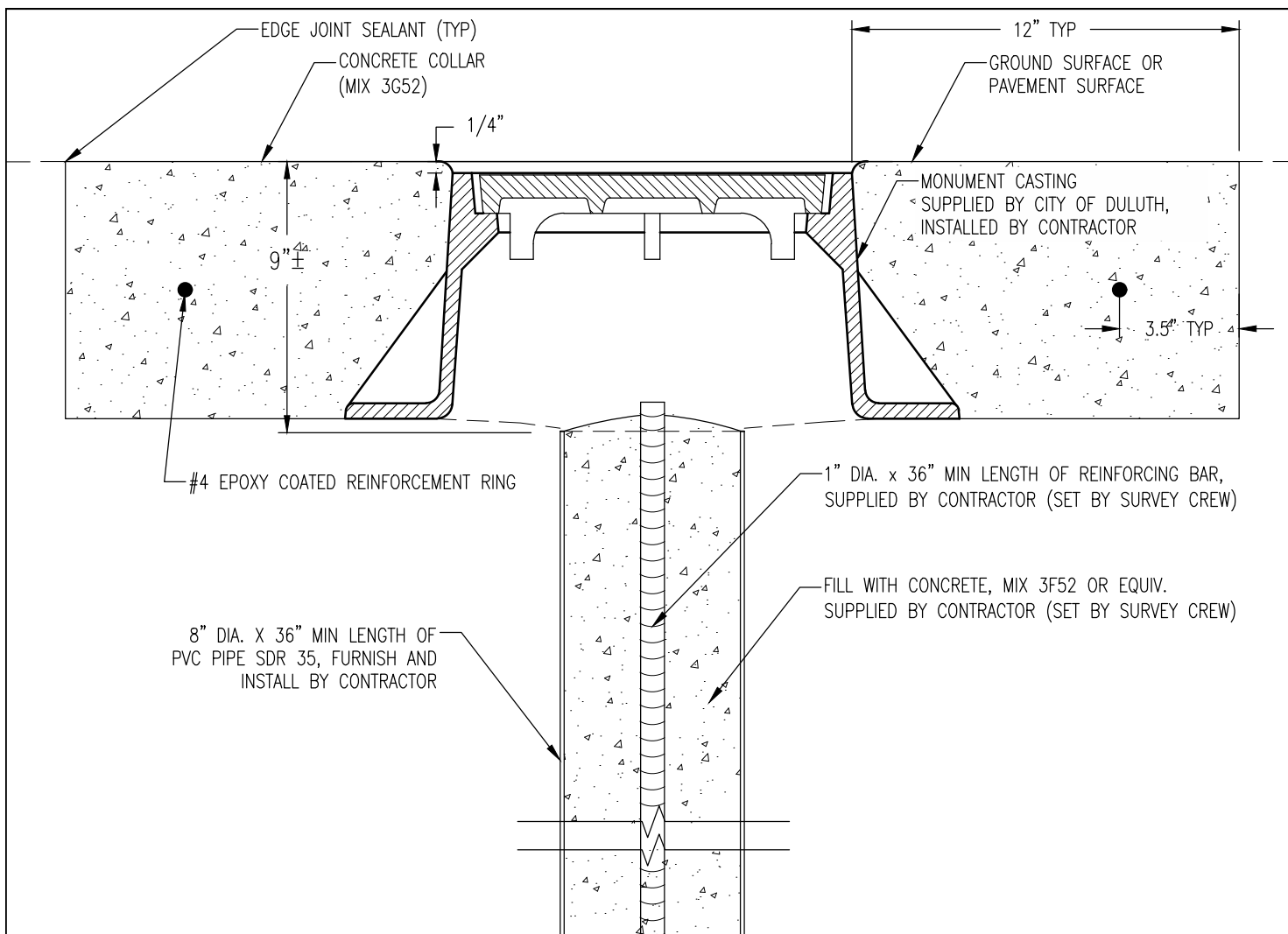
CONSTRUCT SURVEY MONUMENT

SUR-1

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



GENERAL NOTE:

1. LOCATION TO BE DIRECTED AND COORDINATED WITH SURVEY CREW.
2. FRAME & SOLID LID, BOLTED.
3. MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B
4. FINISH: NO PAINT
5. WEIGHT: FRAME 83#, LID 24#.
6. CONCRETE (MIX NO 3G52) COLLAR TO ENCASE CASING.
7. CONCRETE COLLAR SHALL BE CIRCULAR LAYOUT. REMOVE PAVEMENT AND BASE WITH ROTATING CUTTING DEVICE.
8. FINISH CONCRETE EDGE WITH 1/4" RADIUS. SEAL JOINT BETWEEN PAVEMENT AND COLLAR.

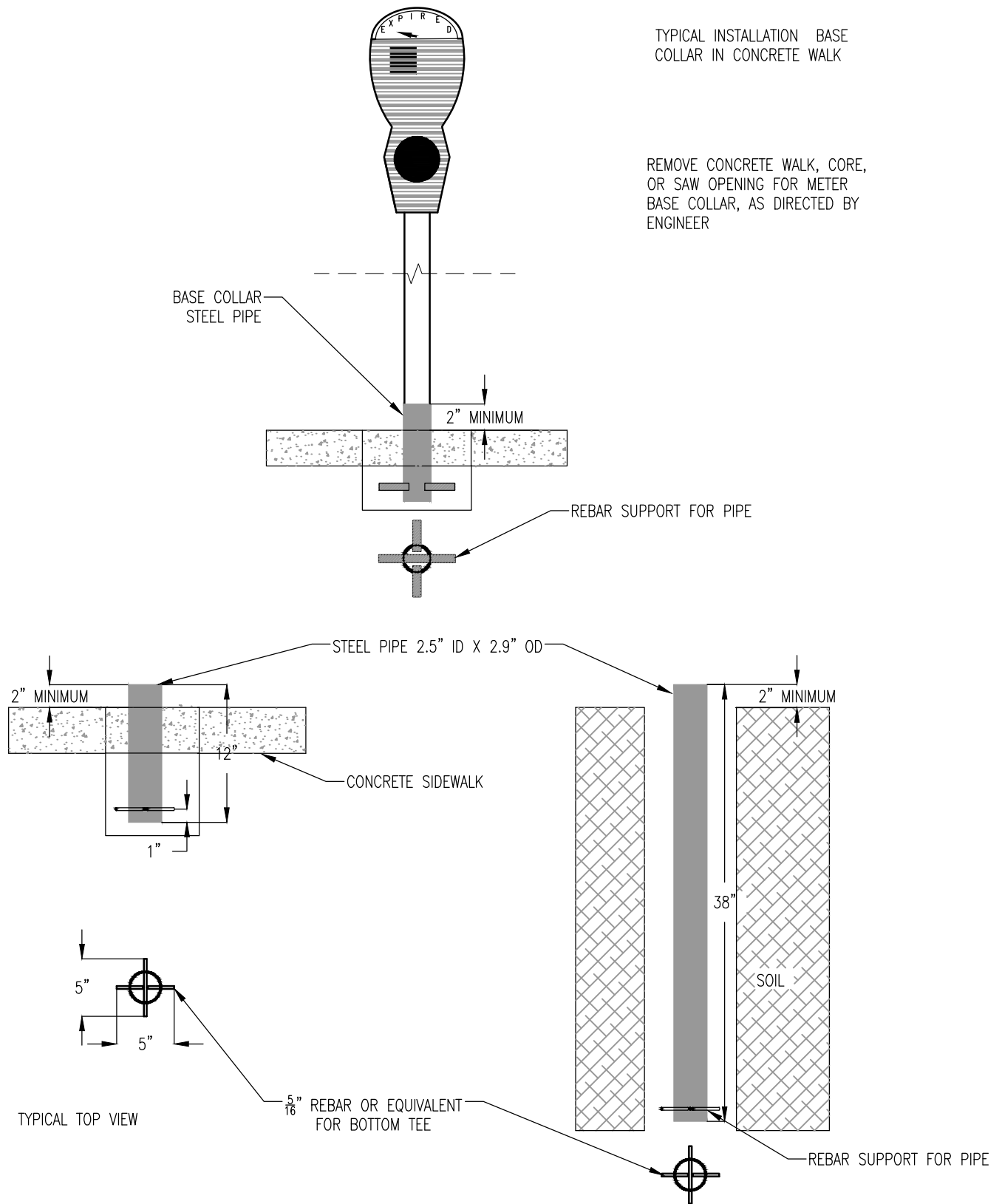
CONCRETE ENCASED CASTING COLLAR IN ROADWAY

SUR-2

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

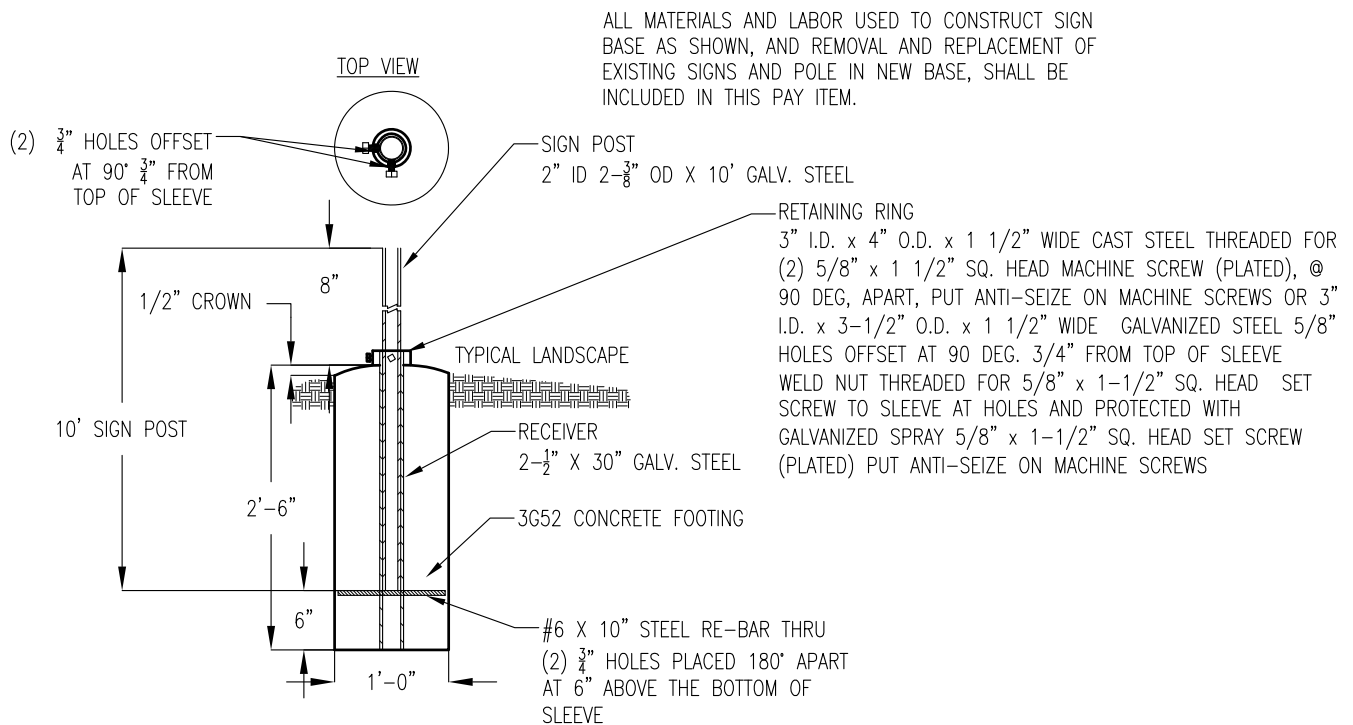
NO SCALE



TYPICAL PARKING METER BASE COLLAR IN
CONCRETE SIDEWALK

TYPICAL PARKING METER BASE COLLAR
INSTALLATION IN SOIL

TYPICAL PARKING METER INSTALLATION		T-1
REVISED/APPROVED 02/01/2013	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



SPEC. 2564.602, REMOVE AND REINSTALL SIGN, EACH

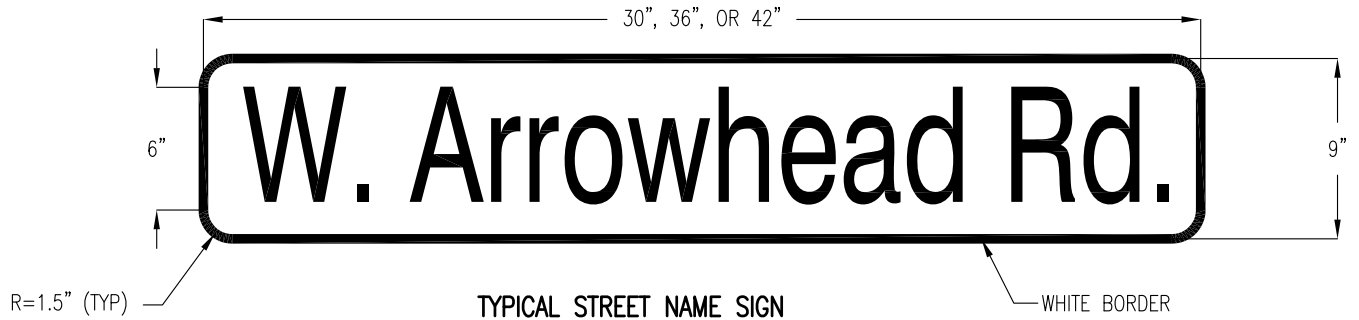
STREET NAME SIGN FOOTING DETAIL

T-3

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

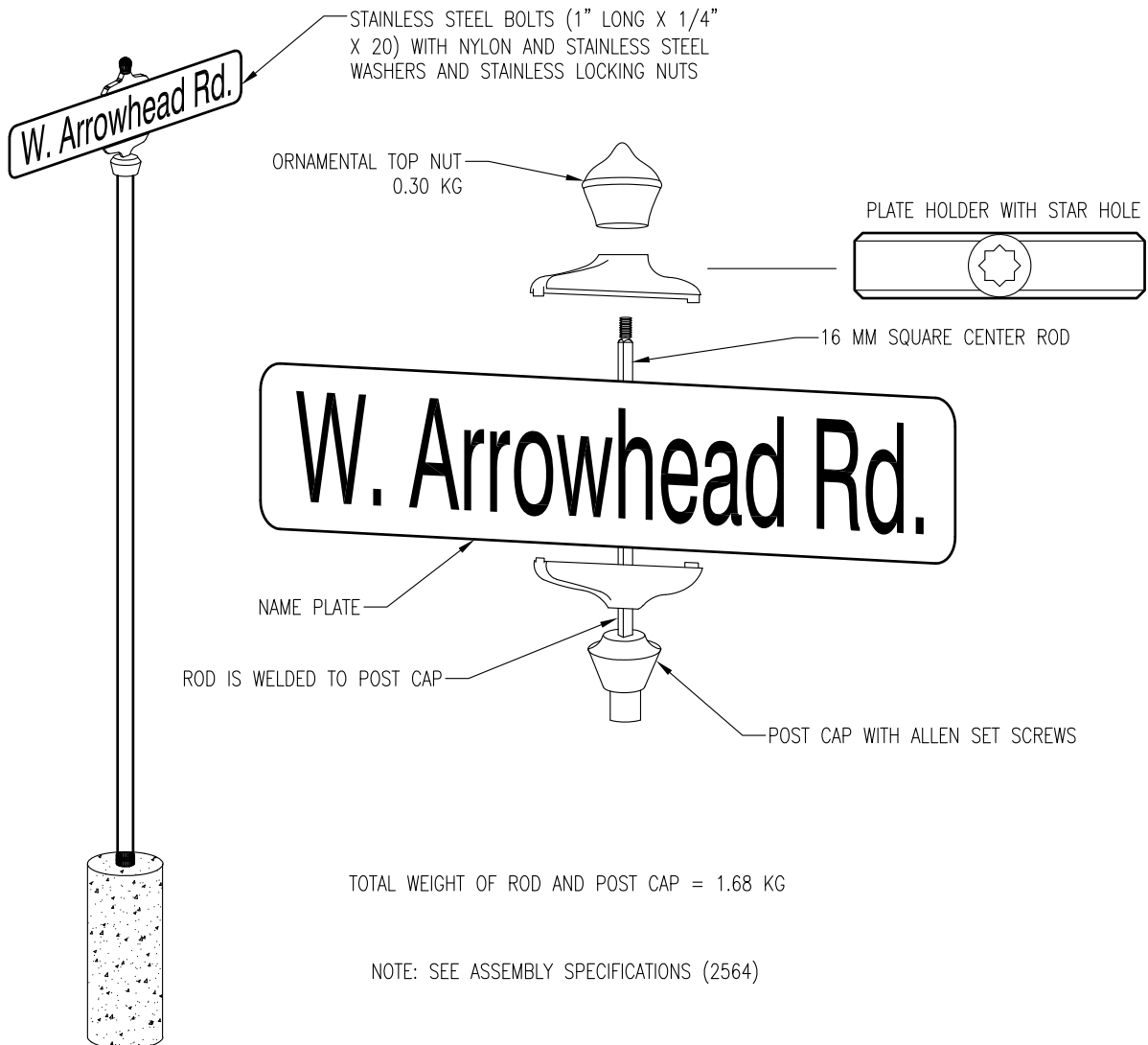
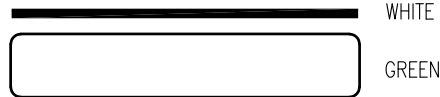
NO SCALE



NOTES:

- LETTERS AND NUMBERS SHALL BE SERIES "C" 6" UPPER AND LOWER CASE
- WHITE BORDER SHALL BE $\frac{3}{8}$ "

LEGEND



TOTAL WEIGHT OF ROD AND POST CAP = 1.68 KG

NOTE: SEE ASSEMBLY SPECIFICATIONS (2564)

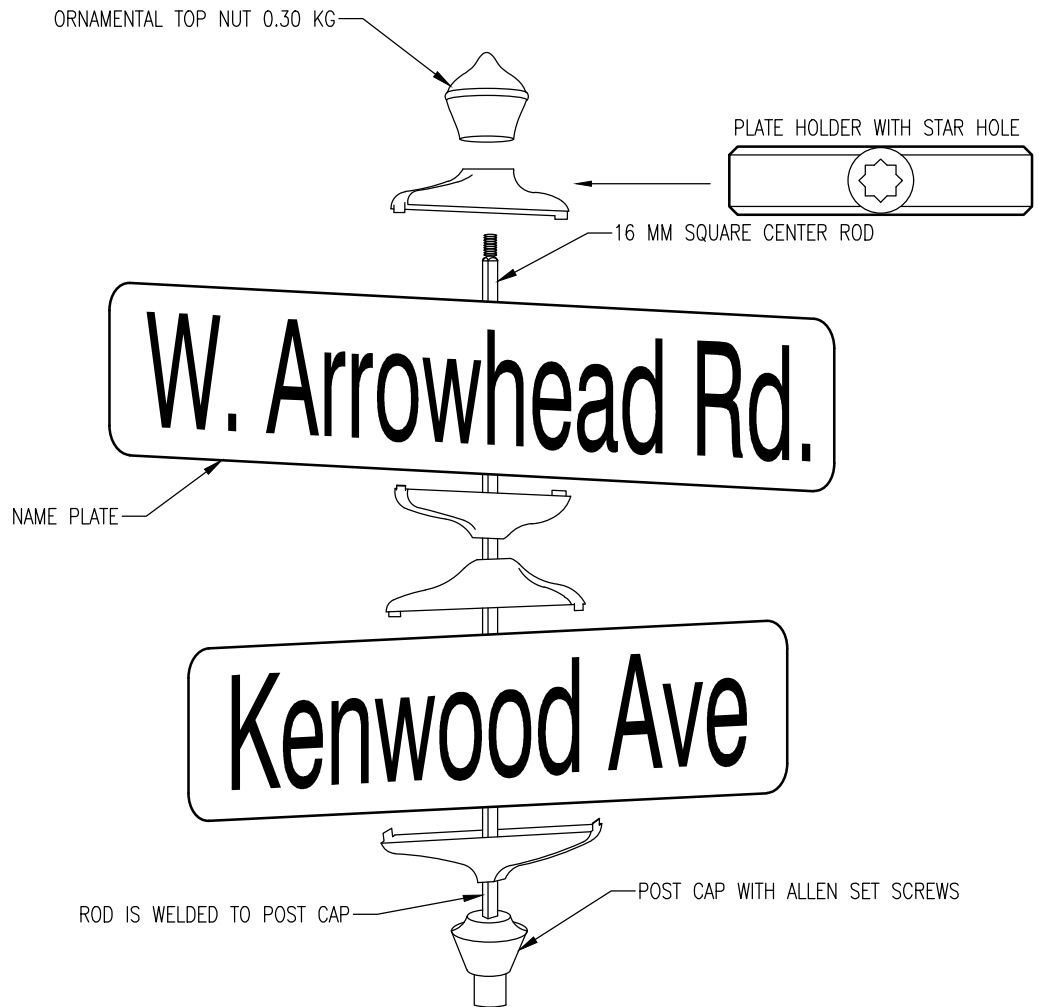
E-250 INSTALLATION

T-4

REVISED/APPROVED 04/01/216

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



TOTAL WEIGHT OF ROD AND POST CAP = 2.15 kg

NOTE: SEE ASSEMBLY SPECIFICATIONS (S-28)

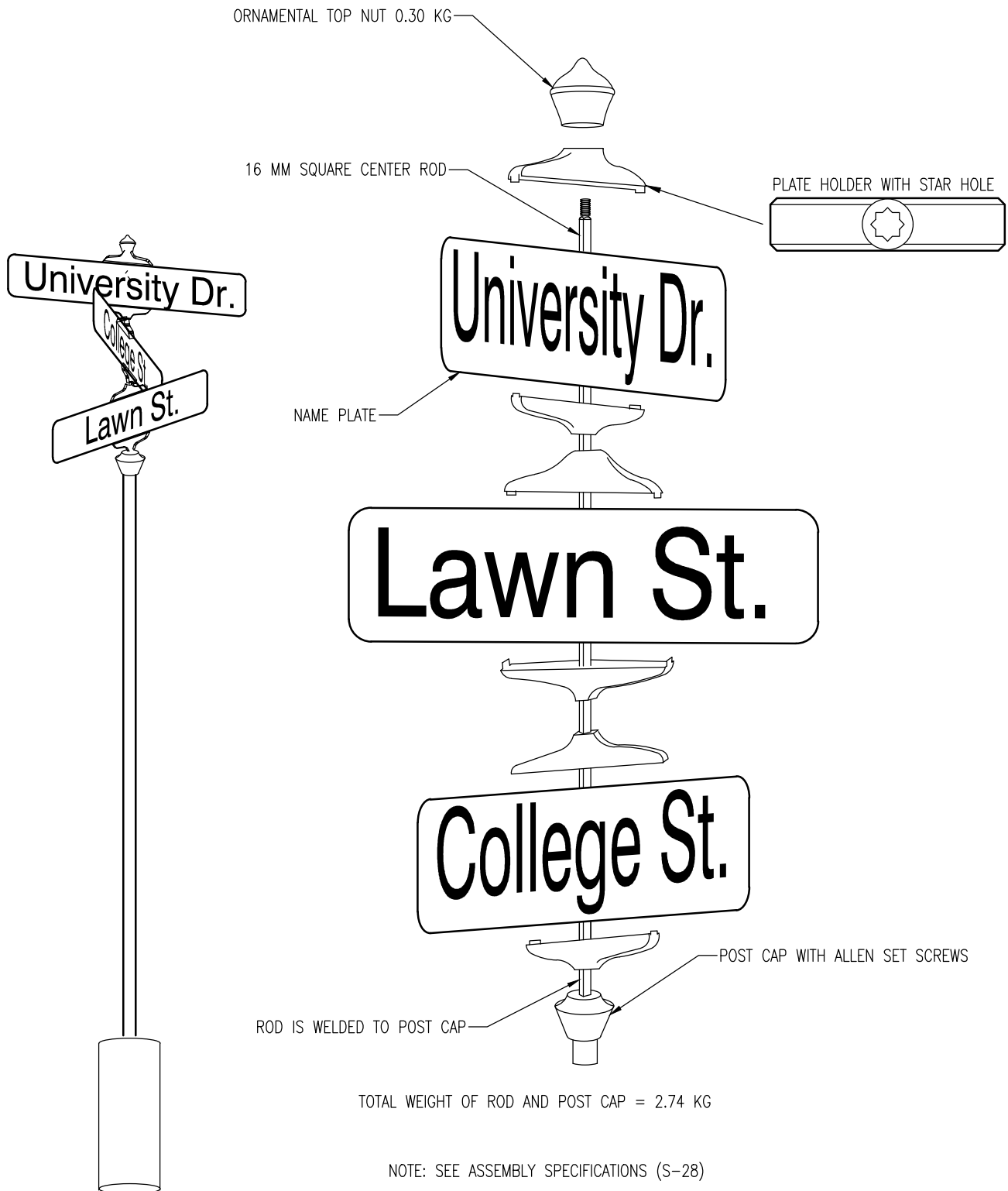
E-450 INSTALLATION

T-5

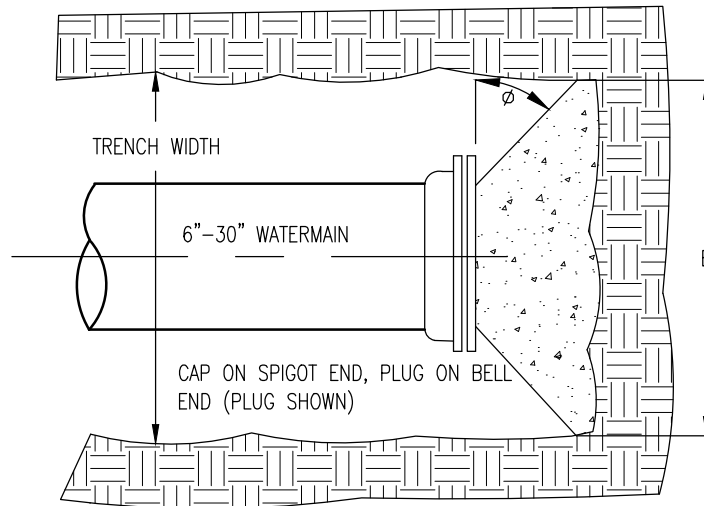
REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

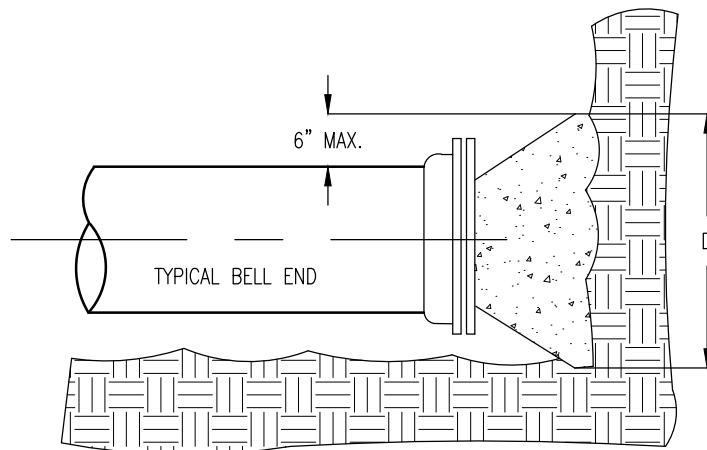
NO SCALE



E-650 INSTALLATION		T-6
REVISED/APPROVED 02/01/2013	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



PLAN



ELEVATION

BLOCKING DIMENSIONS		
PLUG SIZE	B	D
6"	12"	15"
8"	24"	15"
10"	24"	20"
12"	30"	22"
16"	40"	28"
20"	50"	34"
24"	62"	40"
30"	80"	48"

NOTES:

1. BLOCKING DIMENSIONS BASED ON EARTH RESISTANCE OF 2 TONS PER SQ. FT. WHERE, IN THE OPINION OF THE ENGINEER, EARTH IS POOR, BLOCKING SHALL BE INCREASED IN SIZE AS DIRECTED OR STRAPPING MAY BE NECESSARY.
2. ANGLE ϕ SHALL BE EQUAL TO OR LARGER THAN 45°.
3. BLOCKING SHALL BE CENTERED ON MAIN.
4. CONCRETE SHALL BE MIX 3G52 – MNDOT 2461.
5. POLYETHYLENE SHALL BE USED TO SEPARATE CONCRETE FROM FITTING.
6. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

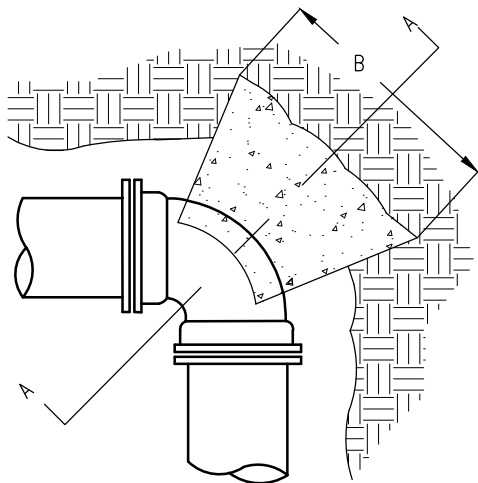
PLUG BLOCKING FOR WATERMAIN

W-2

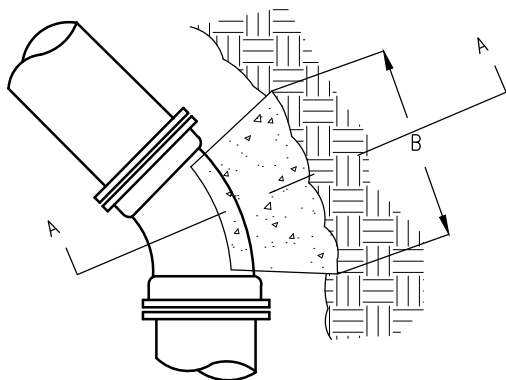
REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

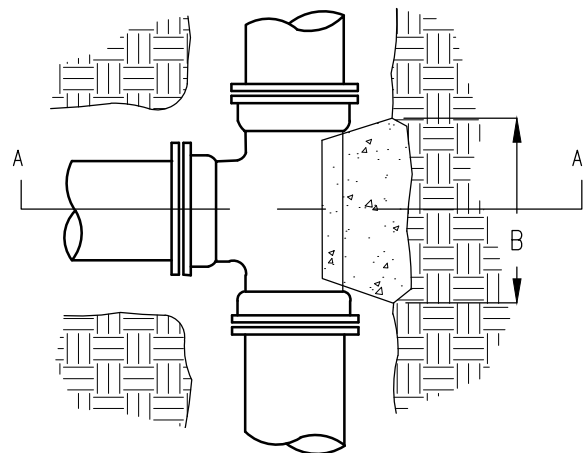
NO SCALE



PLAN - 90° BEND

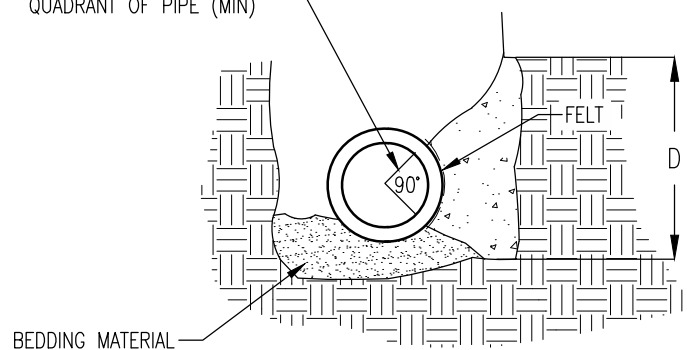


PLAN - 45° BEND



PLAN - TEE

CONCRETE SHALL BE IN CONTACT WITH THIS QUADRANT OF PIPE (MIN)



SECTION A-A

NOTES

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 P.S.I. & AN EARTH RESISTANCE OF 2 TONS/S.F.
2. BLOCKING TO BE SET AGAINST UNDISTURBED SOIL.
3. CONCRETE SHALL BE MIX 3G52. (MNDOT SPEC. 2461) CONCRETE SHALL NOT INTERFERE WITH MECHANICAL JOINTS
4. POLYETHYLENE SHALL BE USED TO SEPARATE CONCRETE FROM FITTING.
5. REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

BLOCKING DIMENSIONS								
BEND OR BRANCH SIZE	22-1/2° BENDS		45° BENDS		90° BENDS		TEES	
	B	D	B	D	B	D	B	D
0'-6"	1'-0"	1'-0"	1'-0"	1'-0"	1'-4"	1'-2"	1'-3"	1'-0"
0'-8"	1'-0"	1'-0"	1'-4"	1'-2"	1'-10"	1'-6"	1'-6"	1'-4"
1'-0"	1'-4"	1'-4"	1'-10"	1'-10"	2'-8"	2'-3"	2'-3"	2'-0"
1'-4"	1'-10"	1'-8"	2'-6"	2'-4"	3'-10"	2'-10"	3'-2"	2'-4"
1'-8"	2'-4"	2'-0"	3'-3"	2'-10"	5'-0"	3'-4"	4'-0"	3'-0"
2'-0"	2'-10"	2'-4"	4'-0"	3'-3"	6'-4"	3'-10"	5'-3"	3'-4"
2'-6"	3'-6"	3'-0"	5'-4"	3'-10"	8'-0"	4'-8"	6'-3"	4'-3"

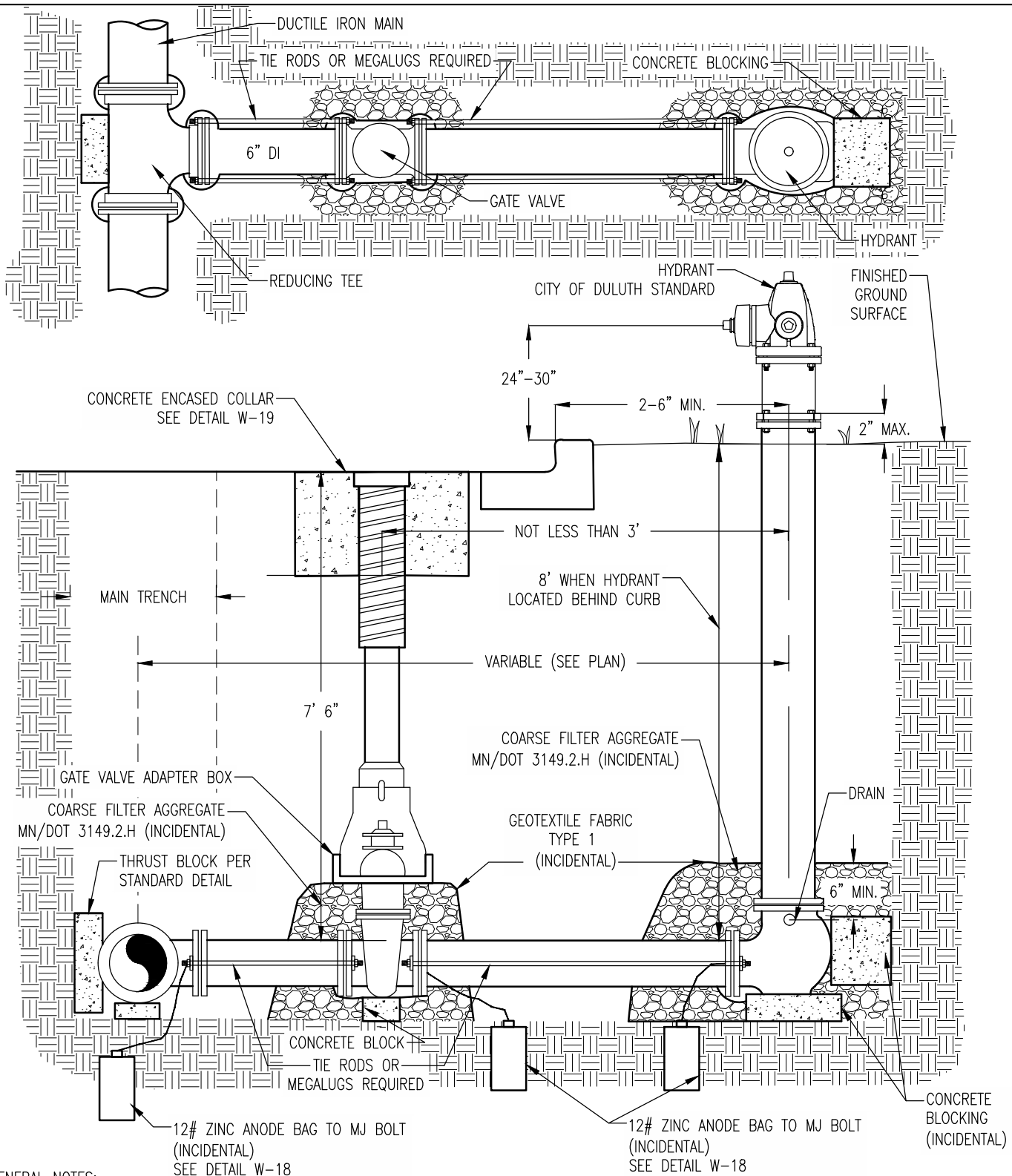
THRUST BLOCKING FOR WATERMAIN

W-3

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



GENERAL NOTES:

1. VALVES SHALL BE CONNECTED DIRECTLY TO AN ANCHORING TEE. WHENEVER DIRECT CONNECTION IS NOT POSSIBLE, TIE RODS OR MEGALUGS SHALL BE USED. TIE RODS SHALL BE GALVANIZED.
2. USE EPOXY COATING ON VALVE AND HYDRANT BASE.
3. ALL BOLTS SHALL BE BLUE COATED COR-TEN WITH 6 OUNCE ZINC ANODE CAPS CONFORMING TO ASTM B-418 FOR ALL MECHANICAL JOINT FITTINGS.
4. GATE VALVES AND HYDRANTS WITH ALPHA RESTRAINT COUPLERS MAY BE USED IN LIEU OF MJ FITTINGS

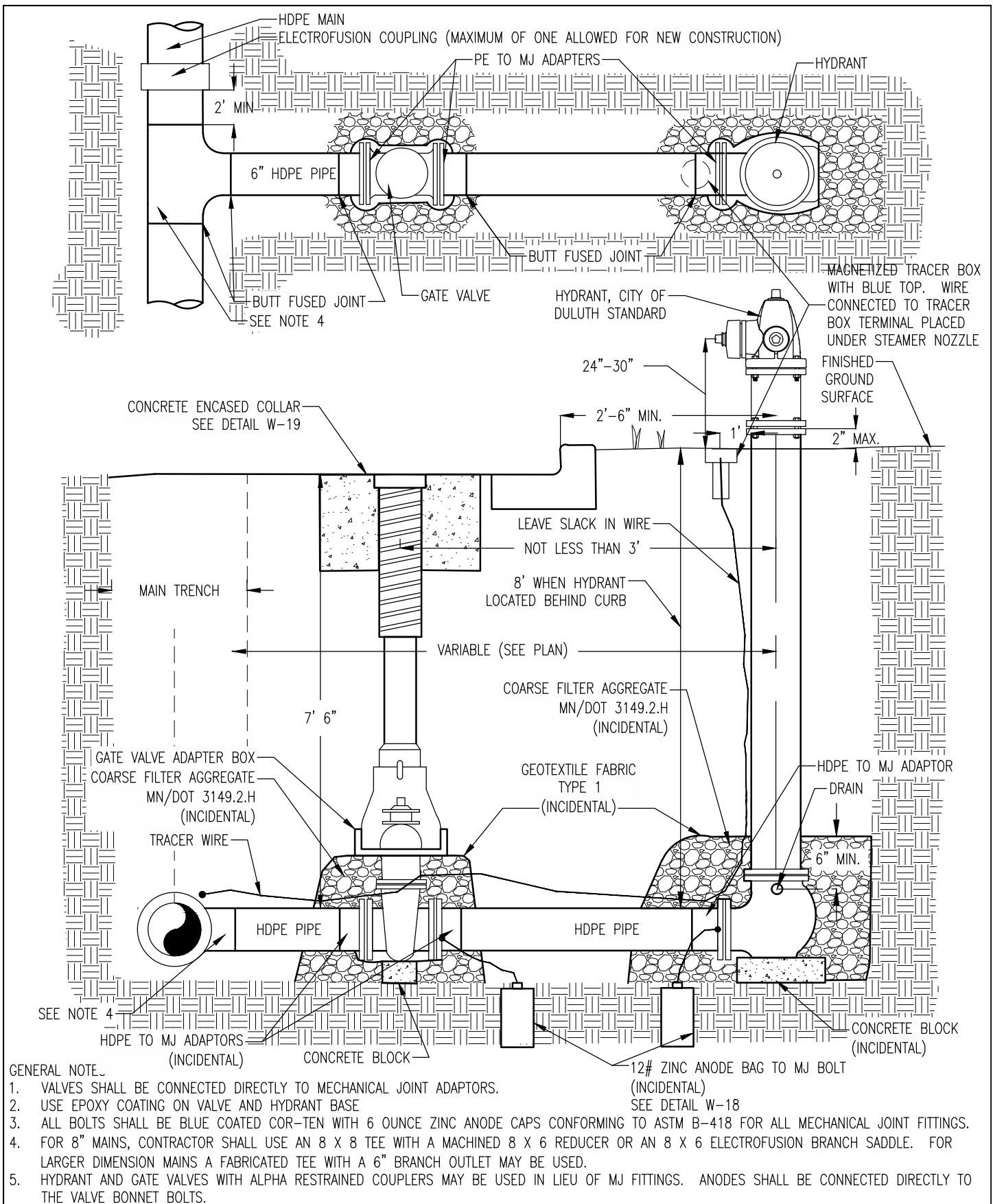
FIRE HYDRANT SETTING DETAIL – DUCTILE IRON

W-4

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



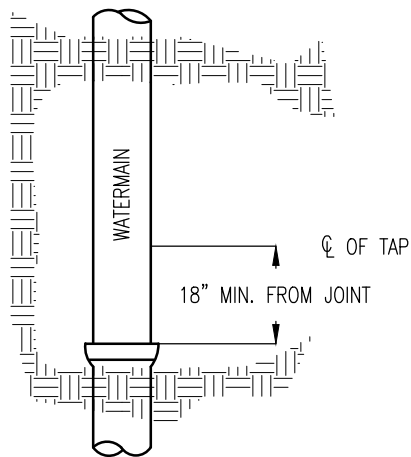
FIRE HYDRANT SETTING DETAIL – HDPE

W-4A

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



TAPPING LOCATION

NOTE: EXCAVATE 6" UNDER IN-PLACE MAIN AND BACKFILL WITH COARSE FILTER AGGREGATE MNDOT SPEC. # 3149.2H. CONTRACTOR SHALL PROVIDE & PLACE A TRENCH BOX WHEN REQUIRED.

CURB BOX WILL BE SUPPLIED BY CITY AT GARFIELD SHOP AND INSTALLED BY CONTRACTOR. (INCIDENTAL)

2" I.D. BLK. IRON CAP ON 6" LONG PIECE OF 2" I.D. BLK IRON SLIPPED OVER 1 1/2" I.D. BLK IRON PIPE.

1 1/2" I.D. BLK. IRON PIPE TOP SECTION SLIPPED IN 2" I.D. BLK. IRON PIPE

2" I.D. BLK IRON PIPE BOTTOM SECTION SCREWED ONTO 2" X 1 1/2" I.D. REDUCING BUSHING

7' 6" MIN. COVER

MN/DOT 3149.2.H
COARSE FILTER AGGREGATE
REQUIRED AROUND CORPORATION
STOP AND CURB STOP

CORPORATION STOP
DIRECT CONNECTION

VARIABLE PAY MEASURE - ONE PIECE

TYPE "K" COPPER
(FLARED FITTING)

BRASS CLAMP

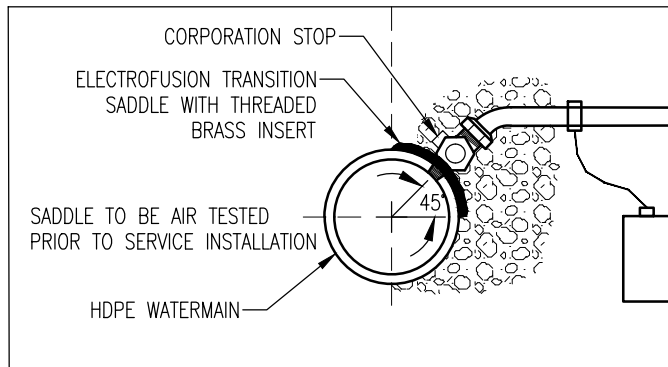
FLARE BY FLARE
CURB STOP

CONCRETE SUPPORT

INSERT LEAD OR PLASTIC
SLUG & TIGHTEN
COUPLING TO SEAL END

5# ZINC ANODE BAG TO BRASS CLAMP
(INCIDENTAL)

DI WATERMAIN



TYPICAL COPPER WATER SERVICE - 3/4", 1", 1-1/4", AND 2"

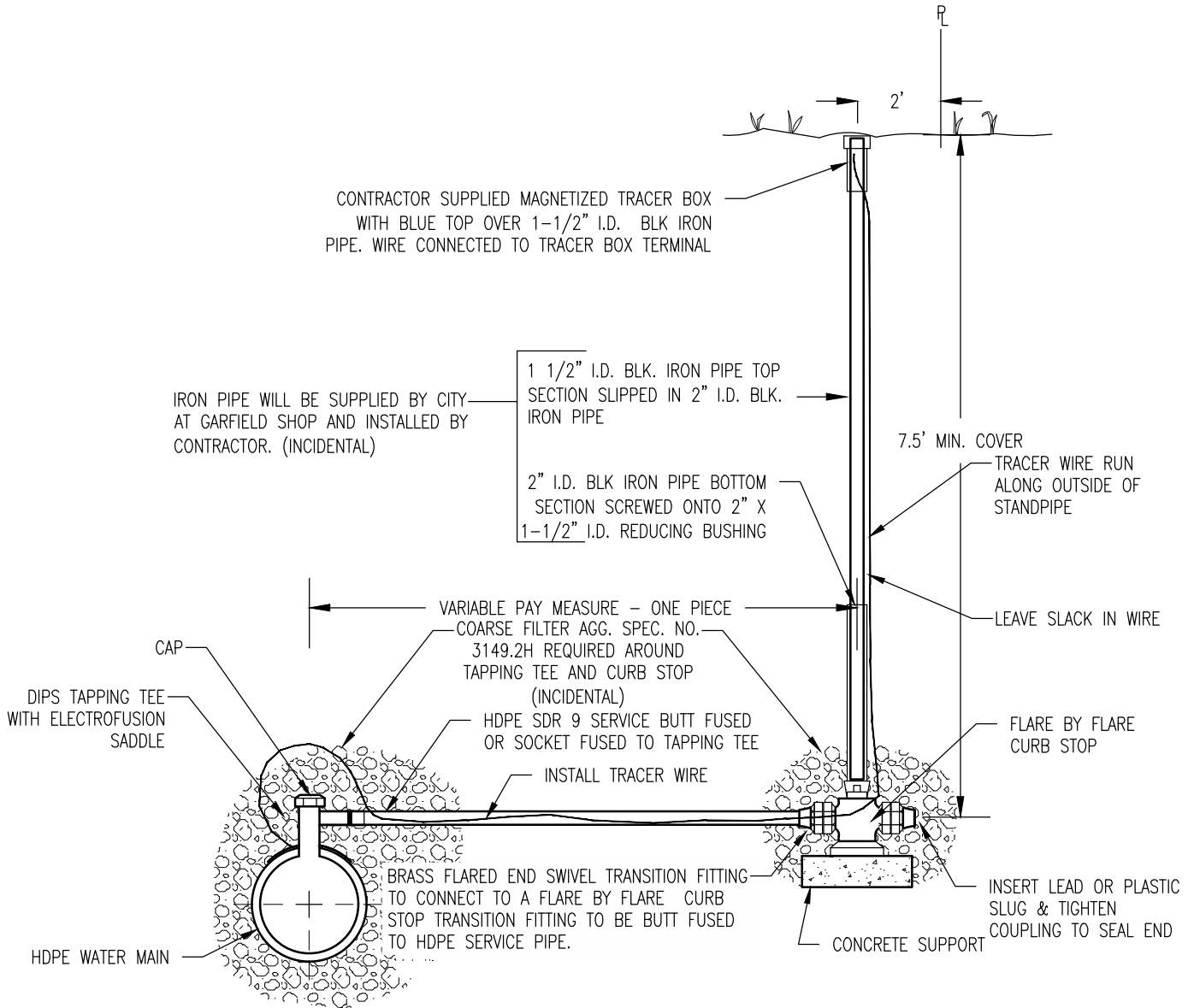
W-5

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

NOTE: EXCAVATE 6" UNDER IN-PLACE MAIN AND BACKFILL WITH COURSE FILTER AGGREGATE MNDOT SPEC. # 3149.2H. CONTRACTOR SHALL PROVIDE & PLACE A TRENCH BOX WHEN REQUIRED.



NOTE: SERVICE TO BE AIR TESTED PRIOR TO TAPPING MAIN

THE TRACER WIRE SHALL REMAIN CONTINUOUS TO THE GREATEST EXTENT POSSIBLE. SPLICES IN THE TRACER WIRE SHOULD BE MADE WITH SPLIT BOLT CONNECTORS. WIRE NUTS OR CLIP TYPE CONNECTOR SHALL NOT BE USED. A WATER-PROOF CONNECTION IS NECESSARY TO PREVENT CORROSION.

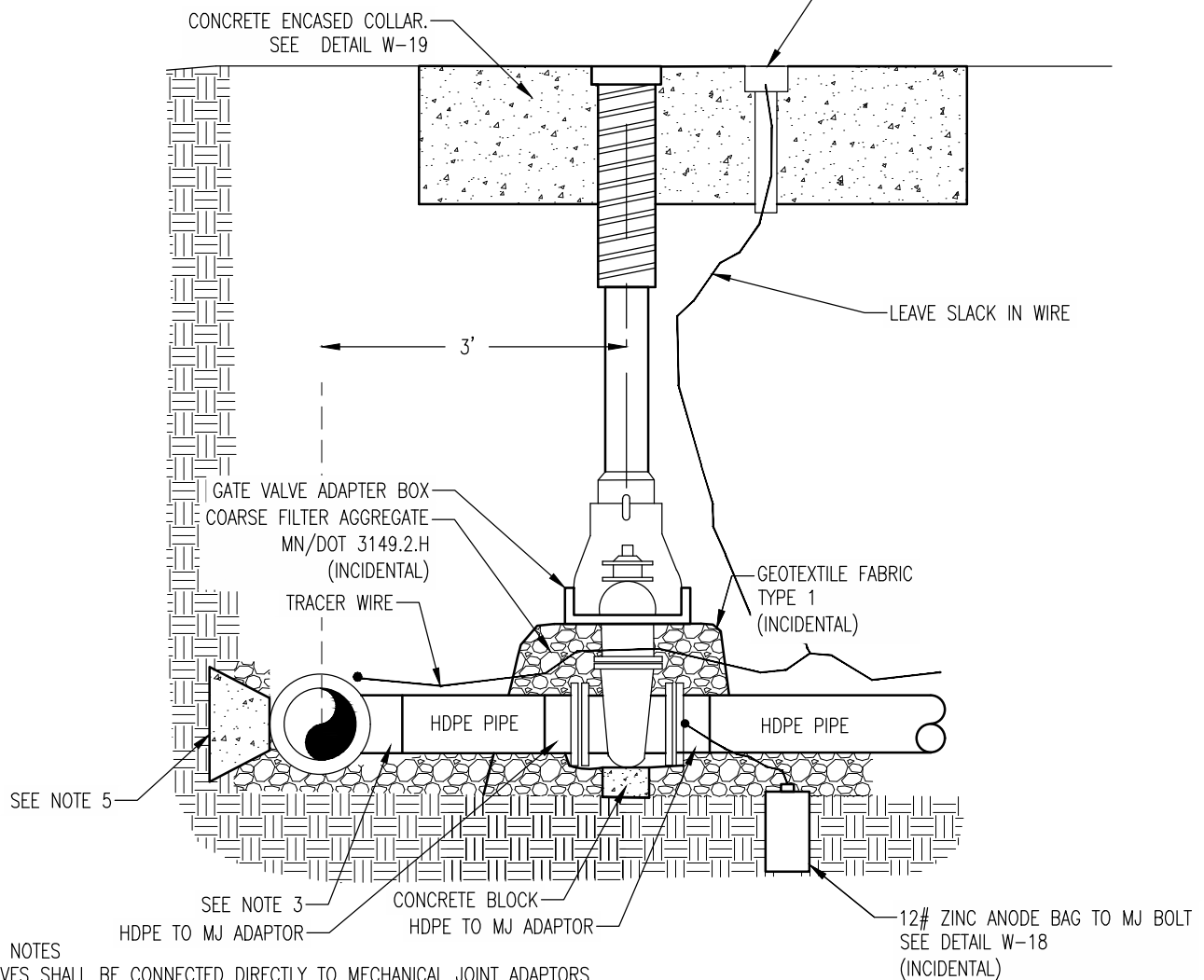
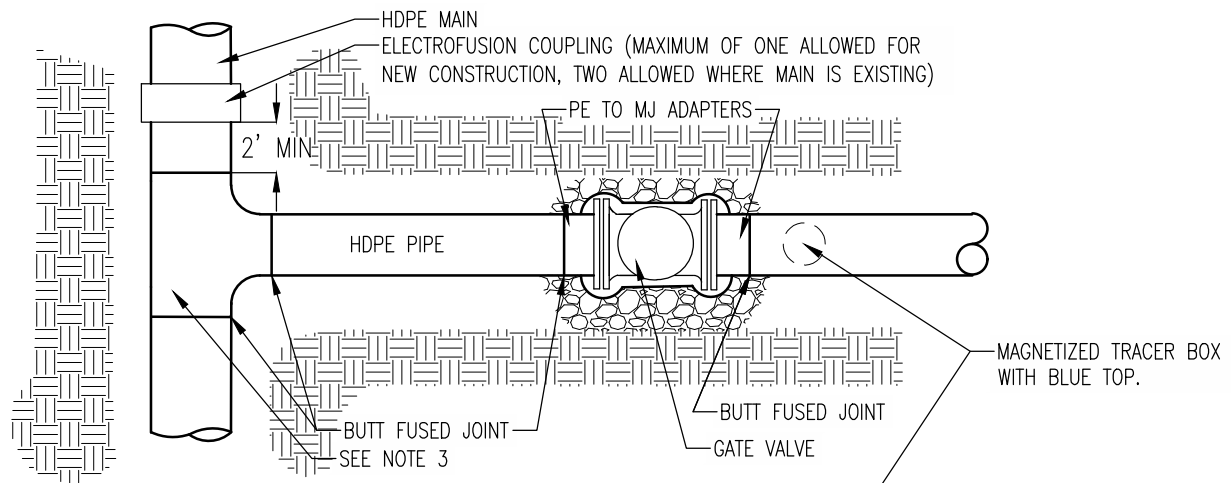
TYPICAL HDPE WATER SERVICE - 1", 1-1/4", AND 2"

W-5A

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



GENERAL NOTES

1. VALVES SHALL BE CONNECTED DIRECTLY TO MECHANICAL JOINT ADAPTORS.
2. ALL BOLTS SHALL BE BLUE COATED COR-TEN WITH 6 OUNCE ZINC ANODE CAPS CONFORMING TO ASTM B-418 FOR ALL MECHANICAL JOINT FITTINGS.
3. FOR 8" MAINS, CONTRACTOR SHALL USE AN 8 X 8 TEE WITH A MACHINED 8 X 6 REDUCER OR AN 8 X 6 ELECTROFUSION BRANCH SADDLE. FOR LARGER DIMENSION MAINS A FABRICATED TEE WITH A 6" BRANCH OUTLET MAY BE USED.
4. GATE VALVES WITH ALPHA RESTRAINT COUPLERS MAY BE USED IN LIEU OF MJ FITTINGS. ANODES SHALL BE CONNECTED DIRECTLY TO THE VALVE BONNET BOLTS.
5. WHEN RECONNECTING TO EXISTING SERVICE PIPING CONCRETE THRUST BLOCKING MAY BE REQUIRED

4" & LARGER WATER SERVICE – HDPE

W-5B

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

DUCTILE IRON MAIN

TIE RODS OR MEGALUGS REQUIRED
SEE NOTE 1

GATE VALVE

REDUCING TEE

TWO TRANSITION COUPLINGS MAY BE USED ON EXISTING MAINS

CONCRETE ENCASED COLLAR
SEE STD. DETAIL W-19

3'-0"

7'-6"

GATE VALVE ADAPTER BOX

COARSE FILTER AGGREGATE
MN/DOT 3149.2.H
(INCIDENTAL)

THRUST BLOCK

GEOTEXTILE FABRIC
TYPE 1
(INCIDENTAL)

12# ZINC ANODE BAG
FASTENED TO MJ BOX
SEE DETAIL W-18
(INCIDENTAL)

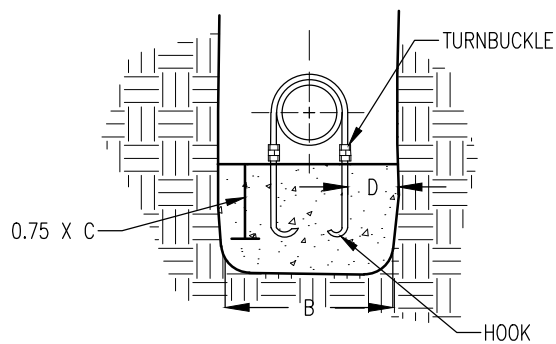
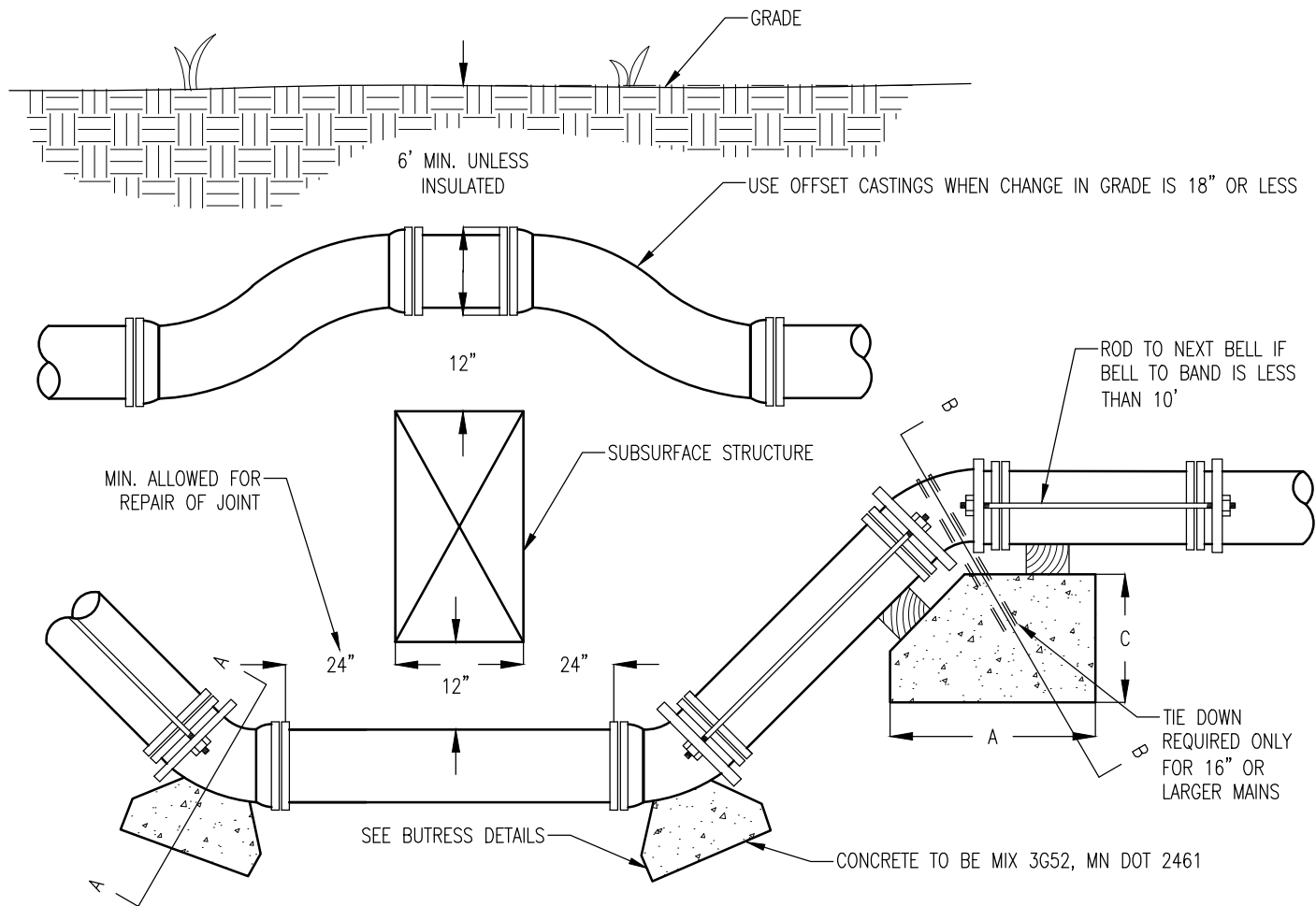
CONCRETE BLOCK

PIPE TO BE WRAPPED
IN POLYETHYLENE

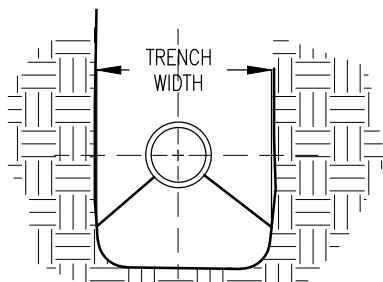
TIE RODS OR MEGALUGS REQUIRED
SEE NOTE #1

1. VALVES SHALL BE CONNECTED DIRECTLY TO AN ANCHORING TEE. WHENEVER DIRECT CONNECTION IS NOT POSSIBLE, TIE RODS OR MEGALUGS SHALL BE USED. TIE RODS SHALL BE GALVANIZED.
2. USE EPOXY COATING ON VALVE.
3. ALL BOLTS SHALL BE BLUE COATED COR-TEN WITH 6 OUNCE ZINC ANODE CAPS CONFORMING TO ASTM B-418 FOR ALL MECHANICAL JOINT FITTINGS.
4. GATE VALVES WITH ALPHA RESTRAINT COUPLERS MAY BE USED IN LIEU OF MJ FITTINGS.

4" & LARGER WATER SERVICE – DUCTILE IRON		W-5C
REVISED/APPROVED 04/05/2019	CITY OF DULUTH STANDARD DETAIL DEPT. OF PUBLIC WORKS AND UTILITIES	NO SCALE



SECTION B-B



SECTION A-A

NOTES:

1. TIE RODS, BOLTS, NUTS, BANDS, AND WASHERS TO BE FURNISHED BY THE CONTRACTOR AND INSTALLED BY CONTRACTOR. ALL RODS AND CONNECTING HARDWARE SHALL BE GALVANIZED. ALL BOLTS SHALL BE BLUE COATED COR-TEN WITH ZINC ANODE CAPS
2. STRAPPING MATERIAL:
 - 2.1. NO. RODS 2 PER TIE
 - 2.2. DIA. RODS 1 INCH
 - 2.3. STRAP SIZE 1/2" X 2"
 - 2.4. BOLT DIA. 3/4"
 - 2.5. WASHER SIZE 1/2" X 3" X 5"
3. OFFSETS FOR 16" WATER MAIN AND LARGER, TIE DOWNS SHALL BE INSTALLED AS SHOWN. TURNBUCKLE AND BLOCK SIZES:

PIPE SIZE	A	B	C	D
16"	6'-0"	2'-6"	3'-0"	0'-1"
20"	8'-0"	3'-0"	3'-0"	0'-1 1/4"
24"	8'-0"	3'-0"	5'-0"	0'-1 1/2"
30"	8'-0"	5'-0"	5'-0"	0'-2"

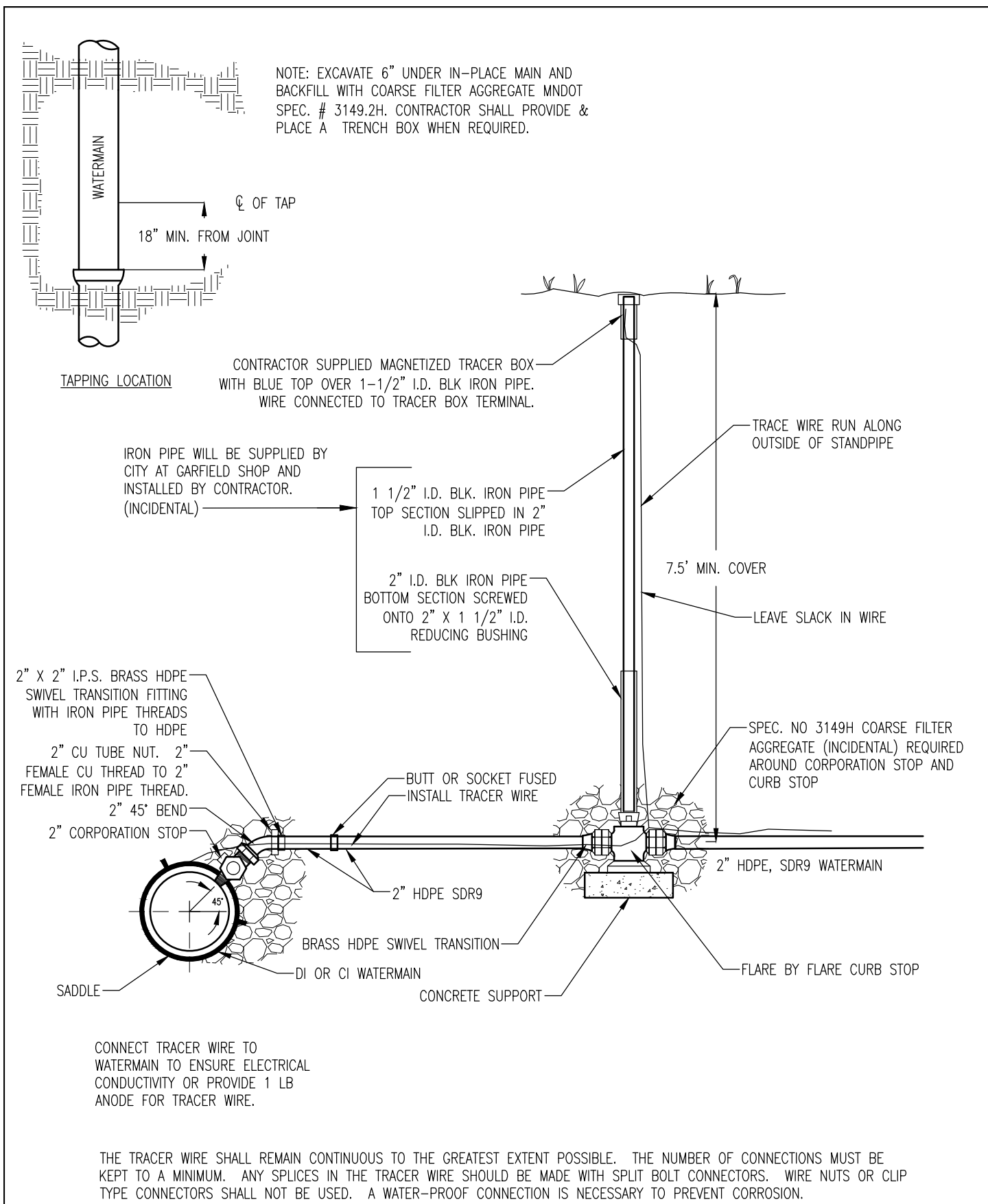
STRAPPING WATERMAIN VERTICAL OFFSETS

W-6

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



2" HDPE WATERMAIN CONNECTION TO DI OR CI

W-7

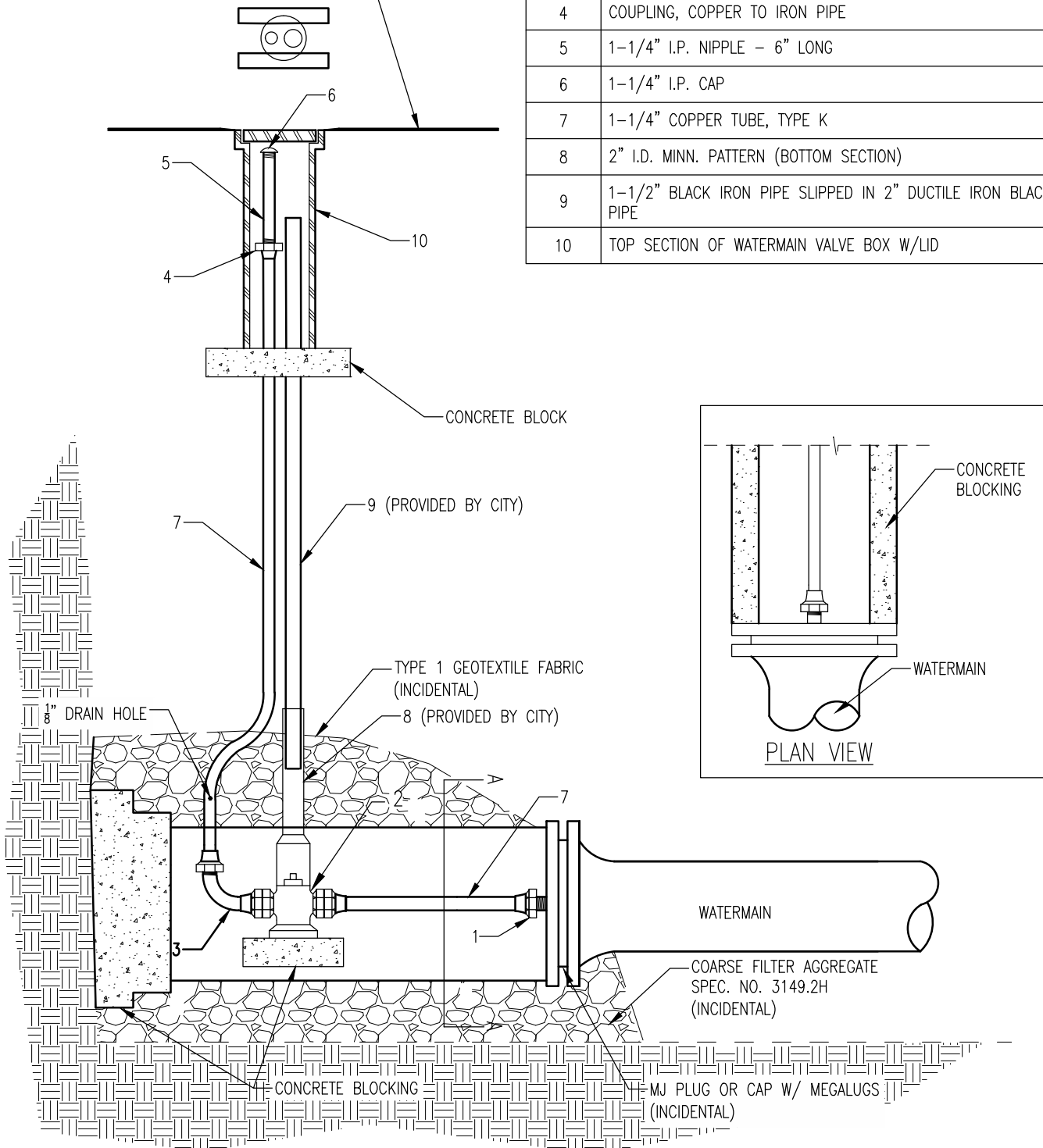
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

NOTE: TOP OF CASTING SHALL BE $\frac{3}{8}$ " BELOW FINISHED SURFACE

ITEM	DESCRIPTION
1	1-1/4" I.P. THREAD TO FLARE COPPER COUPLING
2	1-1/4" CURB STOP, FLARED END FITTINGS
3	1-1/4" 90° BEND W/ COPPER TYPE GASKET CONNECTION TO CURB STOP
4	COUPLING, COPPER TO IRON PIPE
5	1-1/4" I.P. NIPPLE - 6" LONG
6	1-1/4" I.P. CAP
7	1-1/4" COPPER TUBE, TYPE K
8	2" I.D. MINN. PATTERN (BOTTOM SECTION)
9	1-1/2" BLACK IRON PIPE SLIPPED IN 2" DUCTILE IRON BLACK PIPE
10	TOP SECTION OF WATERMAIN VALVE BOX W/LID



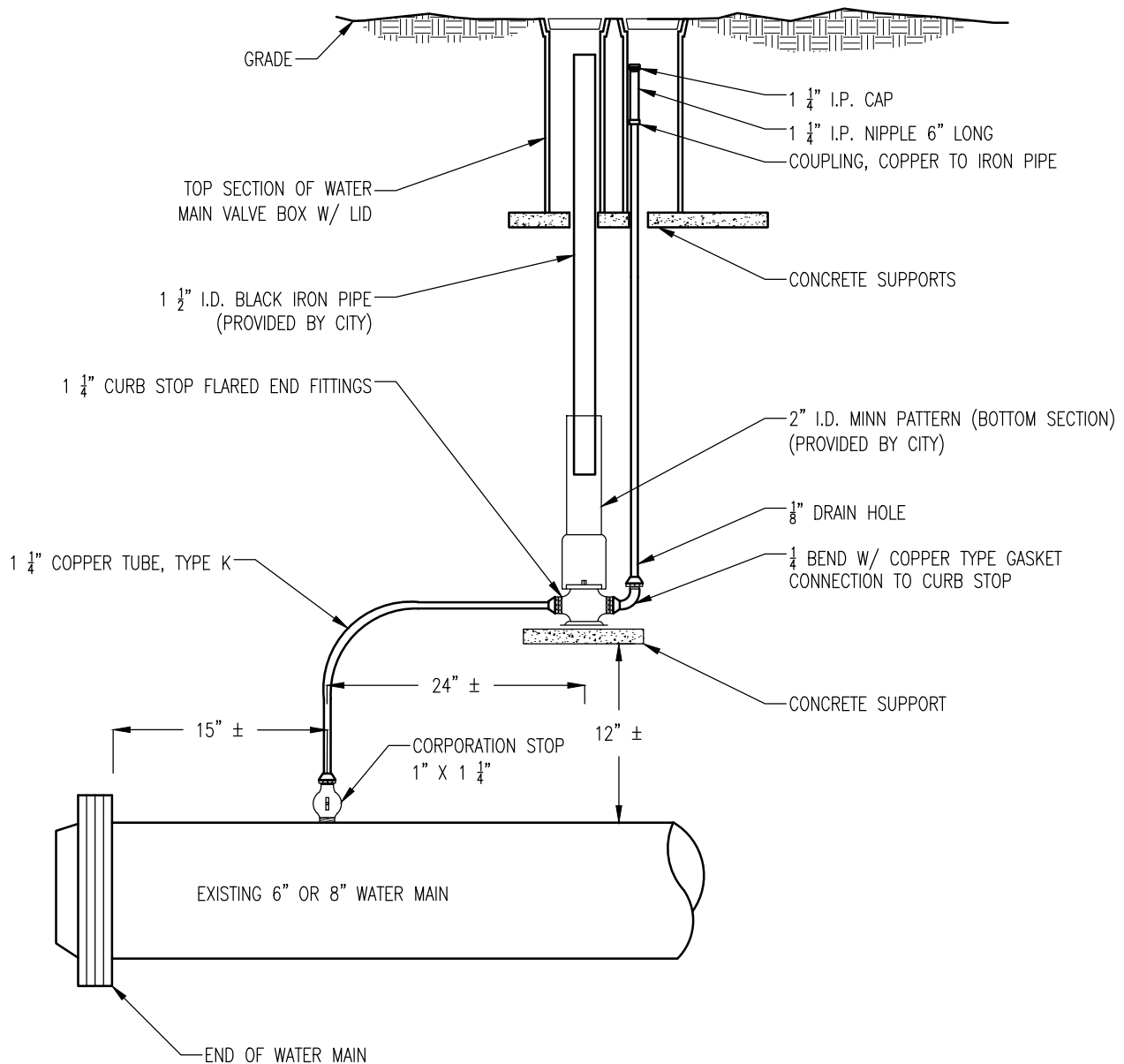
1-1/4" BLOWOFF FOR 6" & 8" IRON WATERMAINS

W-8

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



1-1/4" BLOW OFF (VALVE BOX TYPE) ON EXISTING WATERMAIN

W-8A

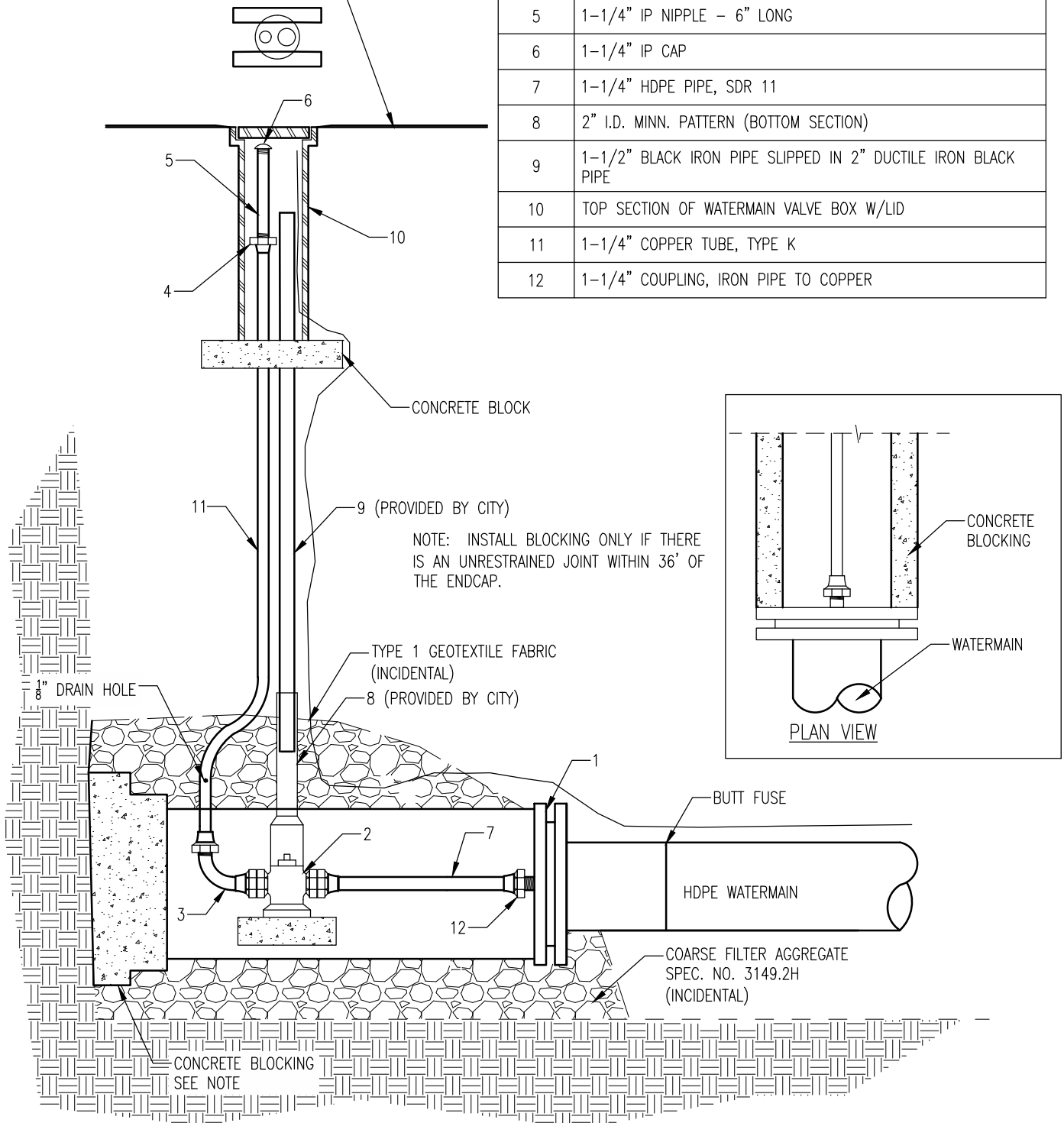
REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

NOTE: TOP OF CASTING SHALL BE
 $\frac{3}{8}$ " BELOW FINISHED SURFACE

ITEM	DESCRIPTION
1	MJ ADAPTOR AND TAPPED DI ENDCAP
2	1-1/4" CURB STOP, FLARED END FITTINGS
3	1-1/4" 90° BEND W/COPPER TYPE GASKET CONNECTION TO CURB STOP
4	1-1/4" COUPLING, COPPER TO IRON PIPE
5	1-1/4" IP NIPPLE - 6" LONG
6	1-1/4" IP CAP
7	1-1/4" HDPE PIPE, SDR 11
8	2" I.D. MINN. PATTERN (BOTTOM SECTION)
9	1-1/2" BLACK IRON PIPE SLIPPED IN 2" DUCTILE IRON BLACK PIPE
10	TOP SECTION OF WATERMAIN VALVE BOX W/LID
11	1-1/4" COPPER TUBE, TYPE K
12	1-1/4" COUPLING, IRON PIPE TO COPPER



1-1/4" BLOWOFF FOR HDPE WATERMAINS

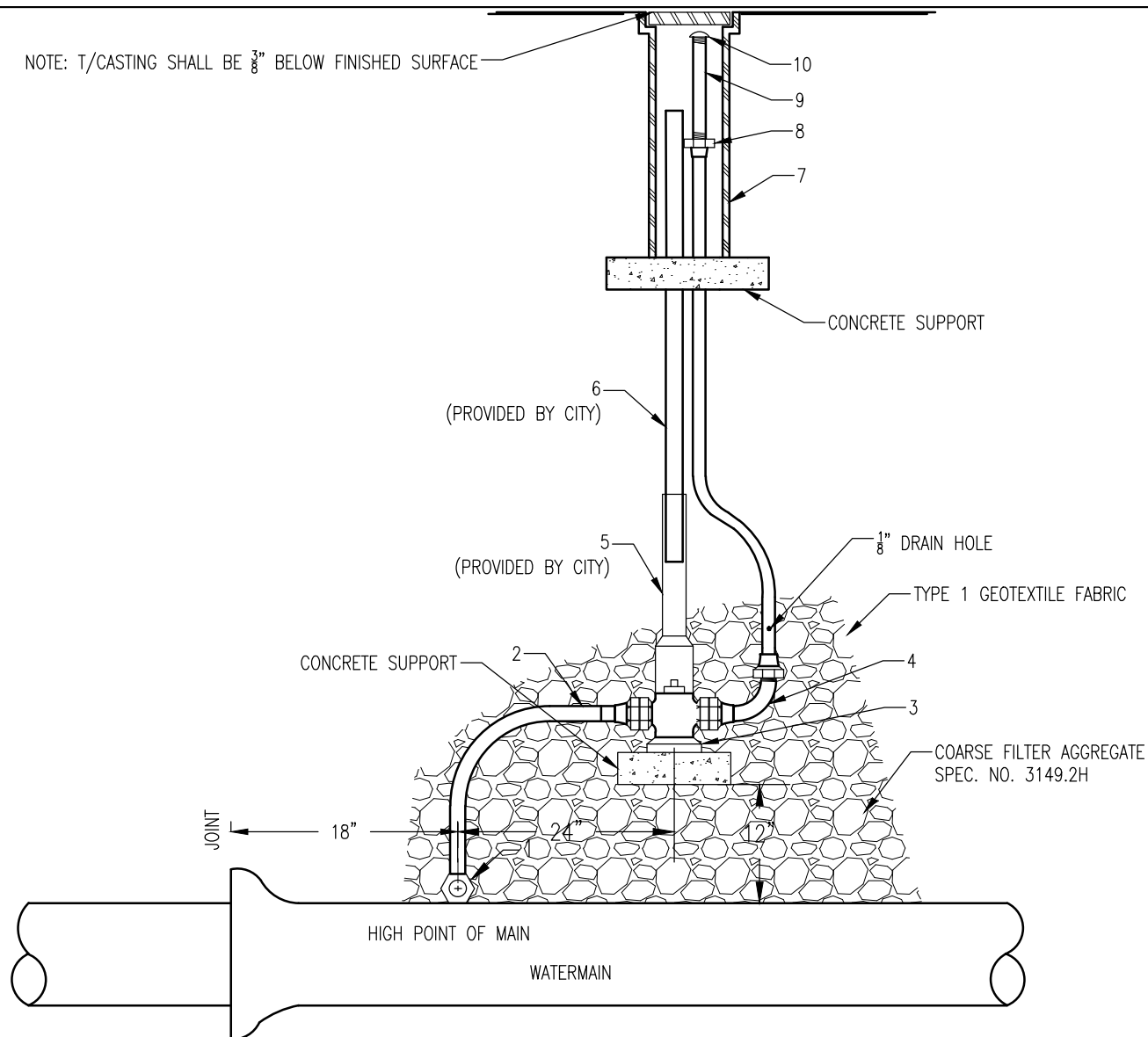
W-8B

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
 DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

NOTE: T/CASTING SHALL BE $\frac{3}{8}$ " BELOW FINISHED SURFACE



ITEM	DESCRIPTION
1	1" CORPORATION STOP
2	1" COPPER TUBE, TYPE K
3	1" CURB STOP, FLARED END FITTINGS
4	1 90° BEND W/ COPPER TYPE GASKET CONNECTION TO CURB STOP
5	2" I.D. MINN. PATTERN (BOTTOM SECTION)
6	1-1/2" I.D. BLACK IRON PIPE
7	TOP SECTION OF WATERMAIN VALVE BOX W/ LID
8	COUPLING, COPPER TO IRON PIPE
9	1" I.P. NIPPLE - 6" LONG
10	1" I.P. CAP

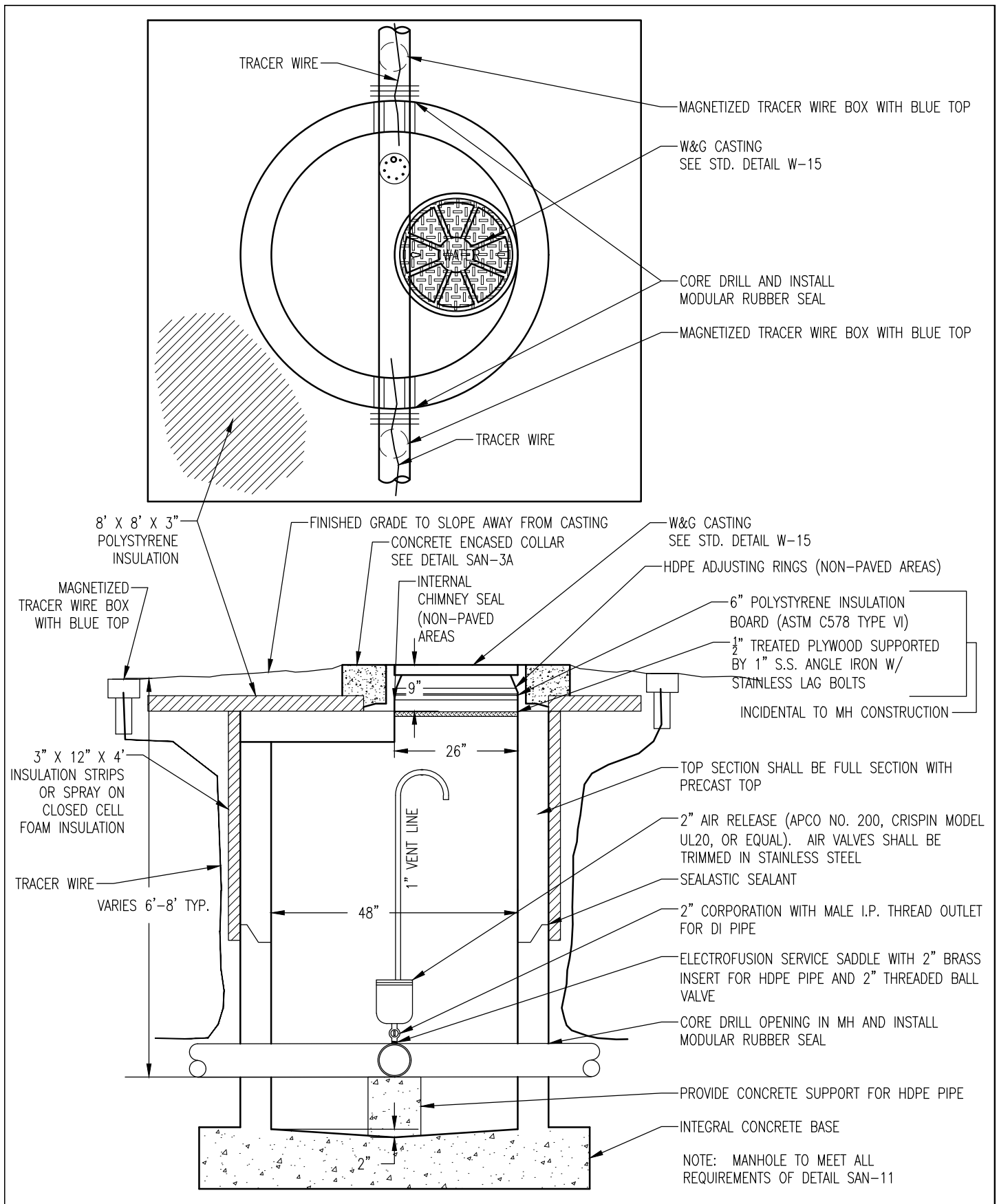
MANUAL AIR RELEASE VALVE BOX TYPE

W-9

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



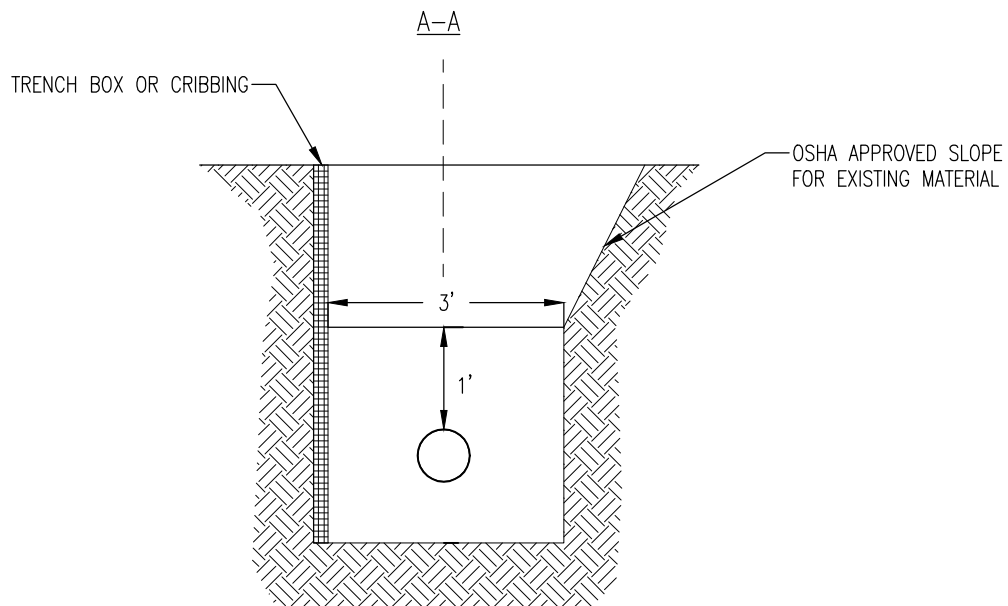
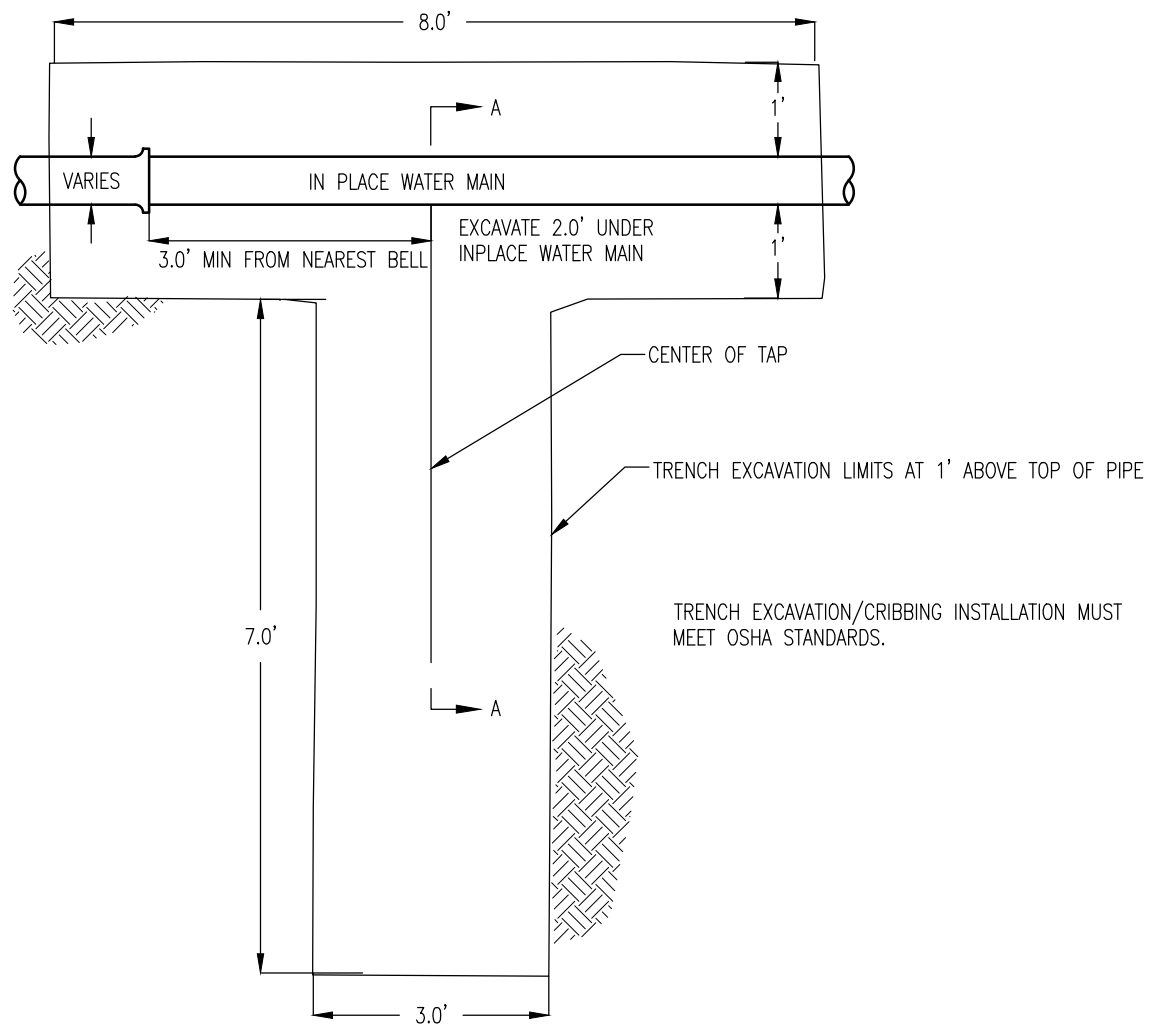
AUTO AIR-RELEASE VALVE AND MANHOLE

W-10

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



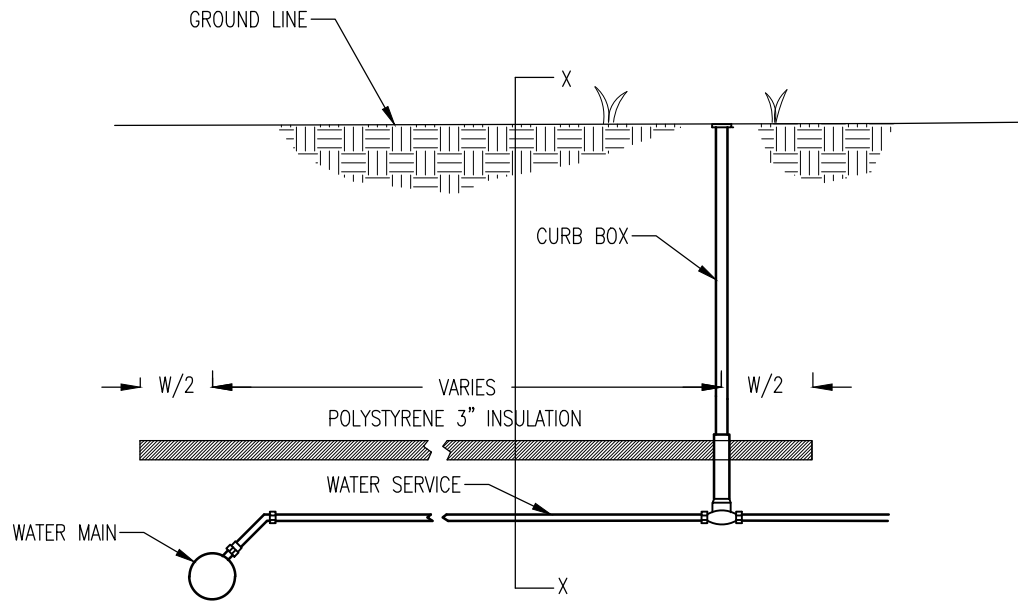
EXCAVATION FOR TAPPING SLEEVE AND VALVE

W-11

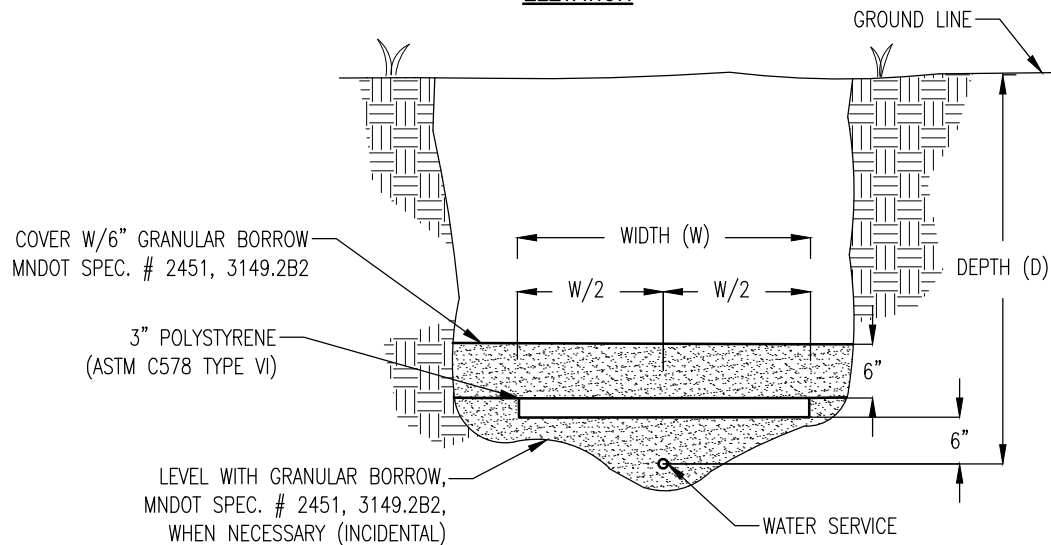
REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



ELEVATION



SECTION X-X

NOTES:

1. LAYERING OF 2 OR 3 SHEETS TO ARRIVE AT 3" IS REQUIRED WITH JOINTS OFFSET A MINIMUM OF 6".
2. POLYSTYRENE SHALL BE AS SPECIFIED IN THE CITY OF DULUTH PUBLIC WORKS AND UTILITIES STANDARD CONSTRUCTION SPECIFICATIONS.
3. INSULATION SHALL ONLY BE USED WHERE APPROVED BY THE ENGINEER.

DEPTH (D)	WIDTH (W)
7' OR MORE	NONE
5.2' TO 6.9'	4'-0"
4.3' TO 5.1'	6'-0"
3.0' TO 4.2'	8'-0"

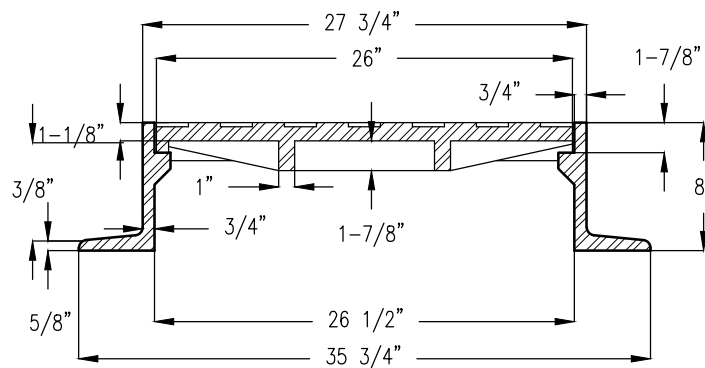
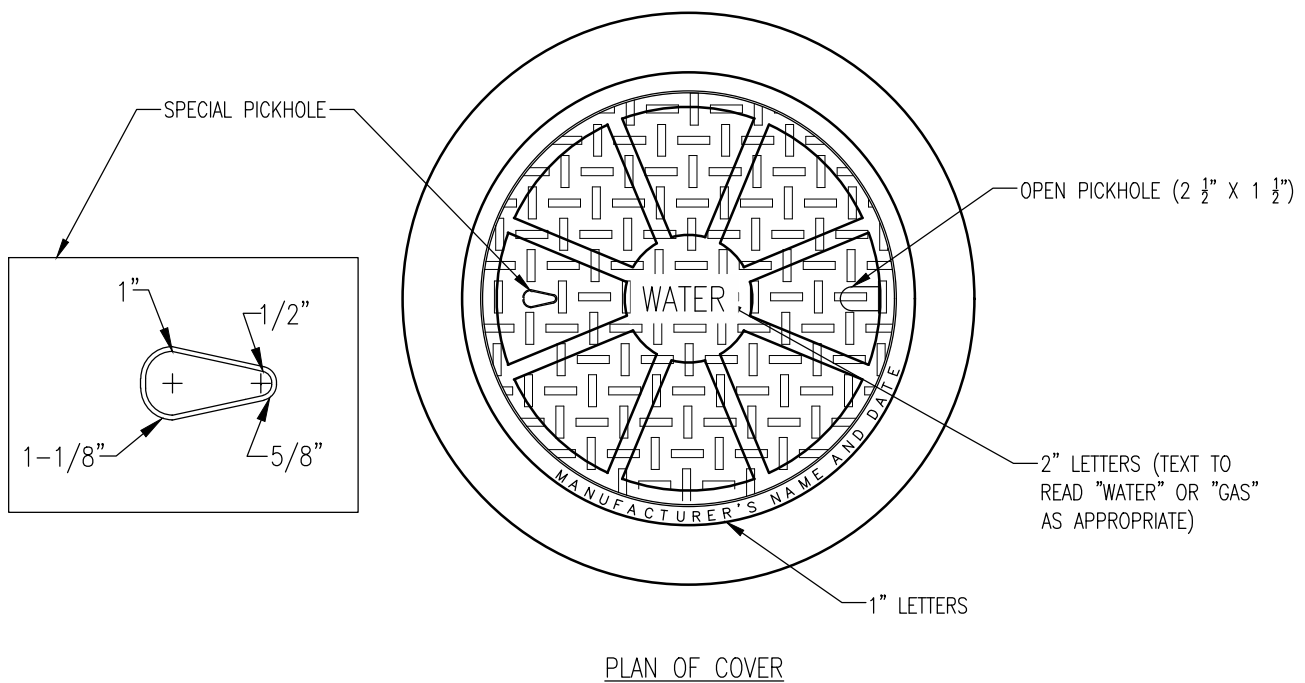
WATER SERVICE INSULATION

W-13

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTE: ROUND OFF ALL EXPOSED EDGES FURNISHED WITH MACHINED HORIZONTAL BEARING SURFACES.
 WEIGHT: RING-295 LBS. COVER - 162 LBS. SIMILAR OR EQUAL TO NEENAH FOUNDRY NQR-1723 (EXCEPT WITH LETTERING AS NOTED)

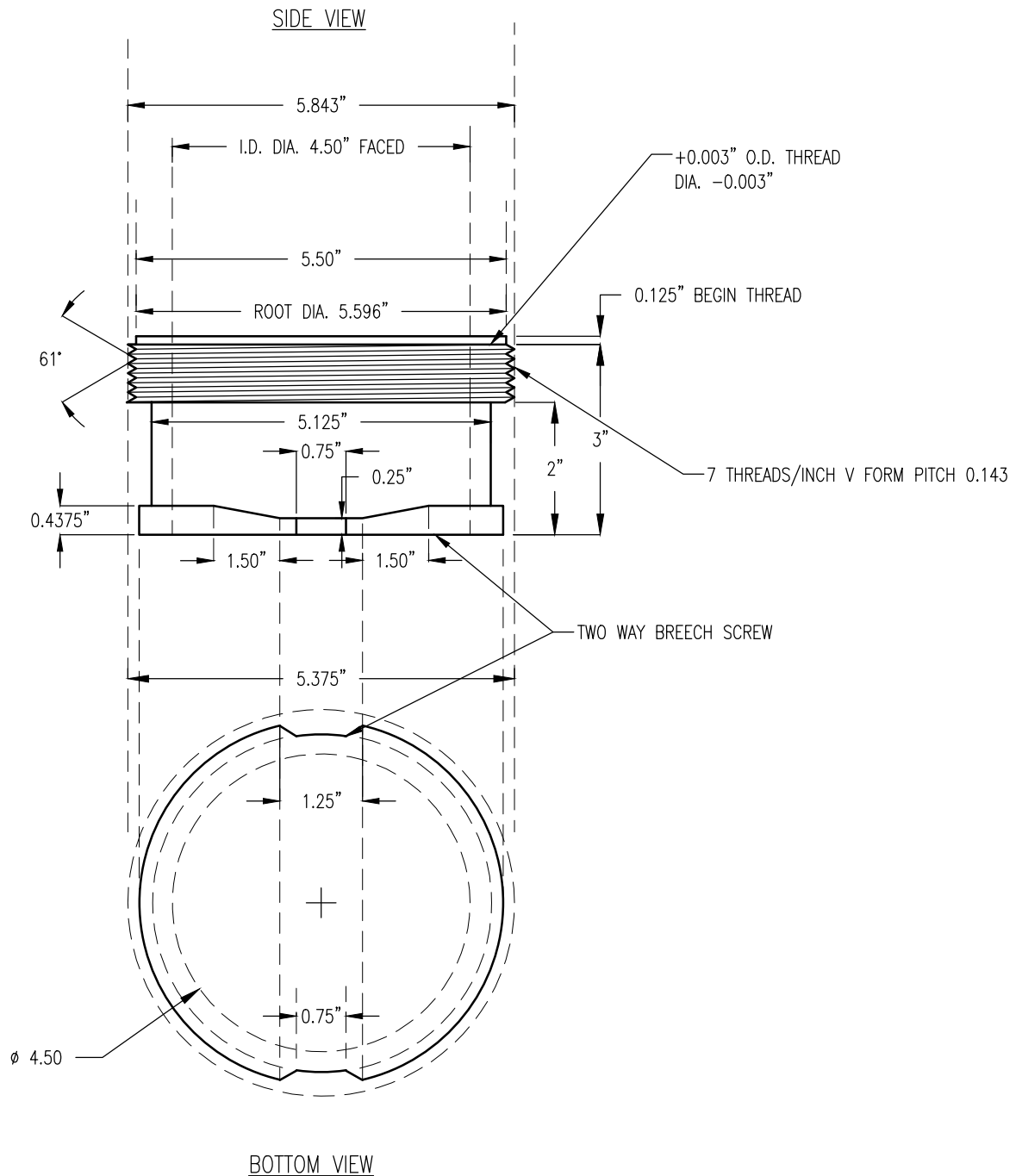
CAST IRON WATER MANHOLE FRAME AND COVER

W-15

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
 DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



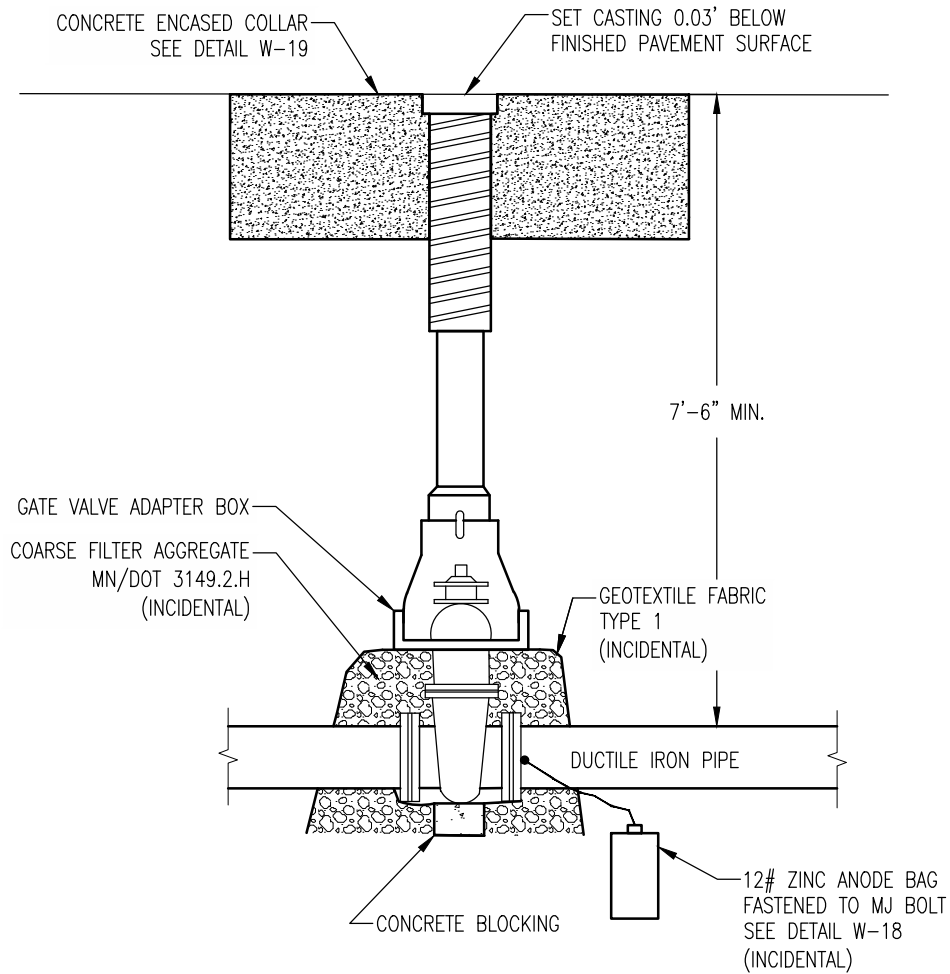
4" & LARGER WATER SERVICE – DUCTILE IRON

W-16

REVISED/APPROVED 01/30/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. USE EPOXY COATING ON EXTERIOR OF VALVES
2. ALL BOLTS SHALL BE BLUE COATED COR-TEN WITH 6 OUNCE ZINC ANODE CAPS CONFORMING TO ASTM B-418 FOR ALL MECHANICAL JOINT FITTINGS.
3. GATE VALVES WITH ALPHA RESTRAINT COUPLERS MAY BE USED IN LIEU OF MJ FITTINGS.

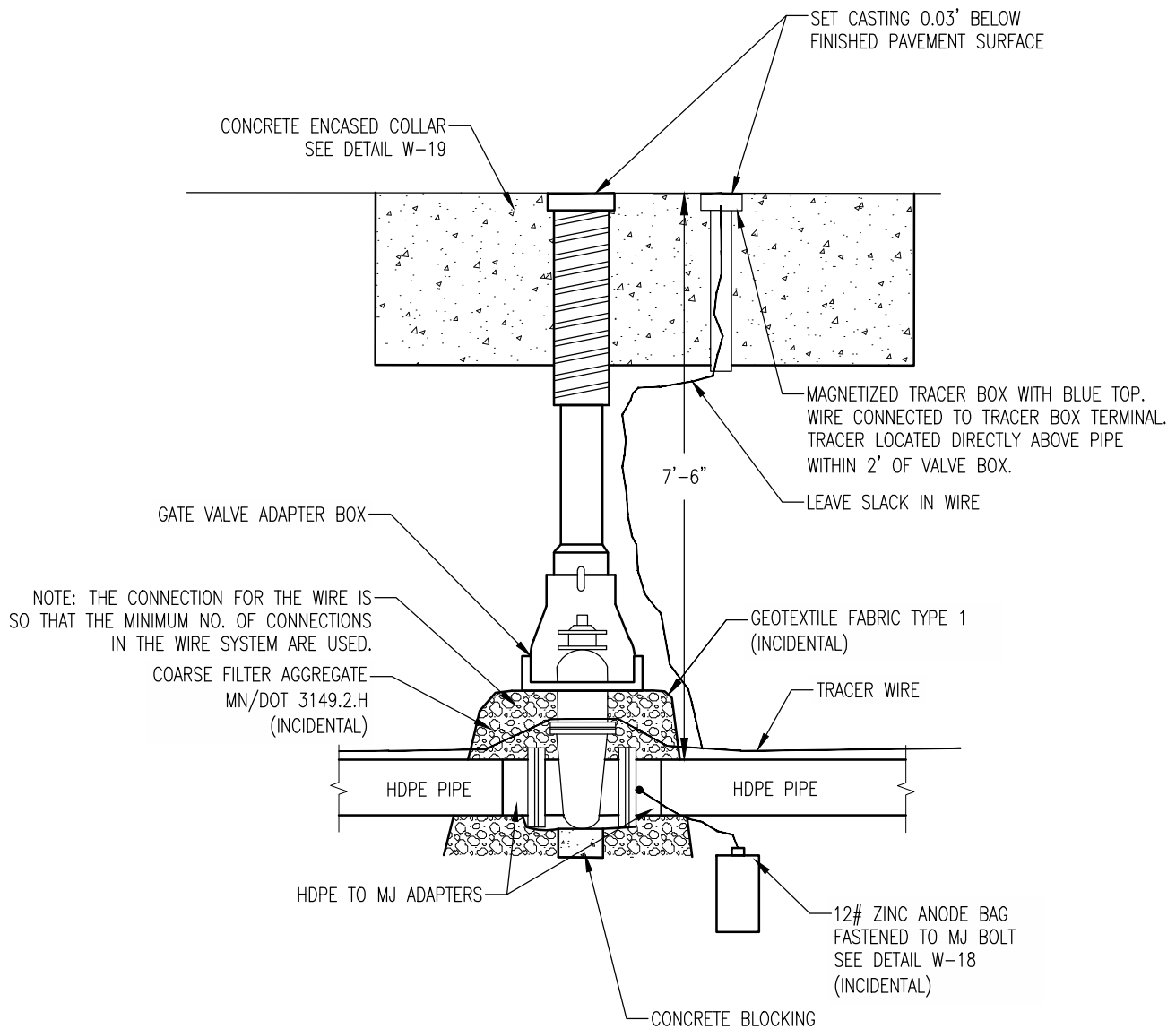
WATER VALVE BOX – DUCTILE IRON MAIN

W-17

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. VALVES SHALL BE CONNECTED DIRECTLY TO HDPE WITH HDPE TO MECHANICAL JOINT ADAPTERS.
2. USE EPOXY COATING ON EXTERIOR OF VALVES.
3. ALL BOLTS SHALL BLUE COATED BE COR-TEN WITH 6 OUNCE ZINC ANODE CAPS CONFORMING TO ASTM B-418 FOR ALL MECHANICAL JOINT FITTINGS.
4. FOR OPEN CUT PIPE INSTALLATIONS, ELECTROFUSION COUPLINGS ARE NOT ALLOWED FOR CONNECTION OF HDPE TO MJ ADAPTERS. FOR DIRECTIONAL DRILLED INSTALLATIONS, ONE ELECTROFUSION COUPLING MAY BE USED PER VALVE.
5. GATE VALVES WITH ALPHA RESTRAINT COUPLERS MAY BE USED IN LIEU OF MJ FITTINGS. ANODE SHALL BE CONNECTED DIRECTLY TO THE VALVE BONNET BOLTS.

WATER VALVE BOX – HDPE MAIN

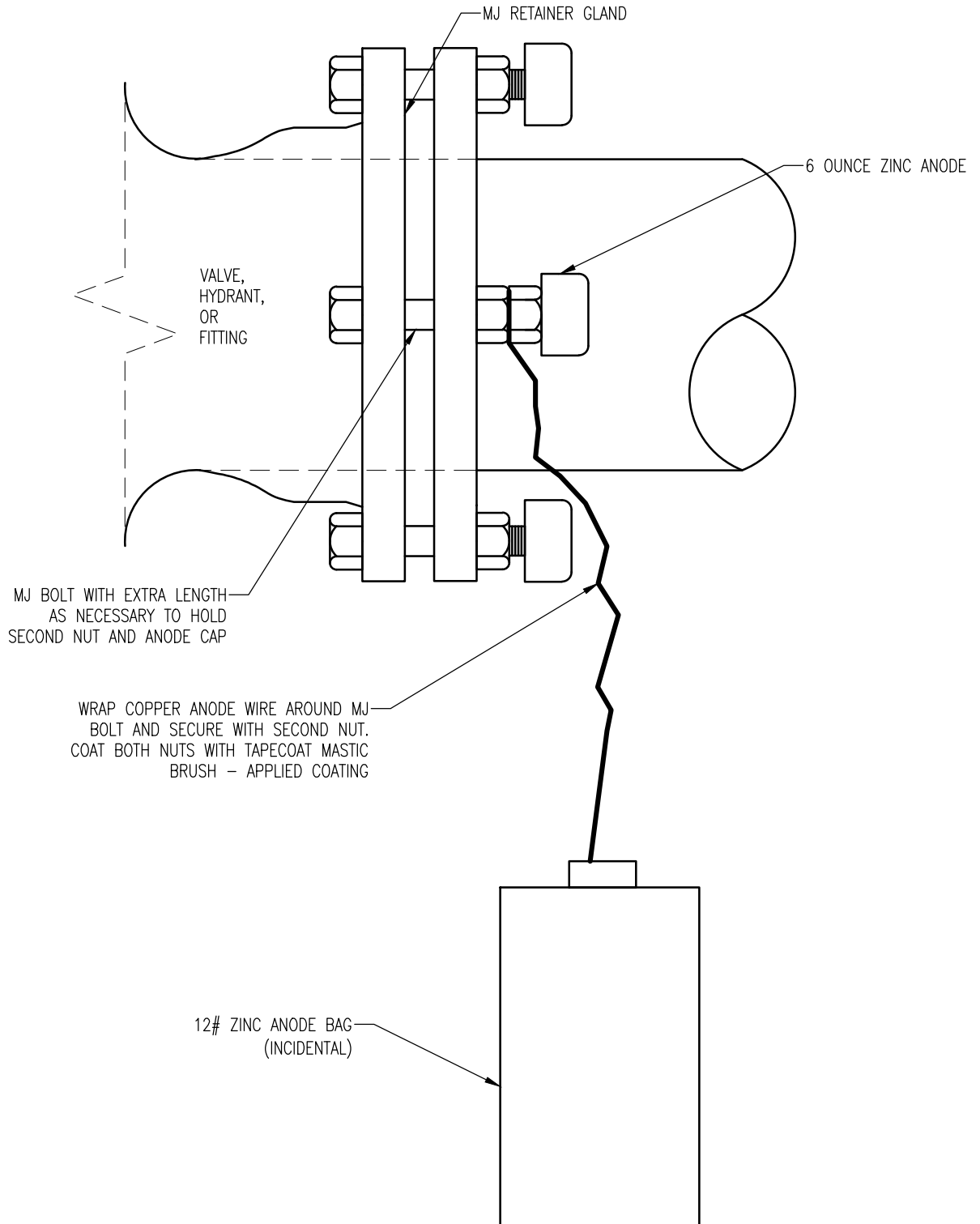
W-17A

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE

NOTE: ALL DUCTILE IRON VALVES, HYDRANTS, OR FITTINGS SHALL RECEIVE ANODES.



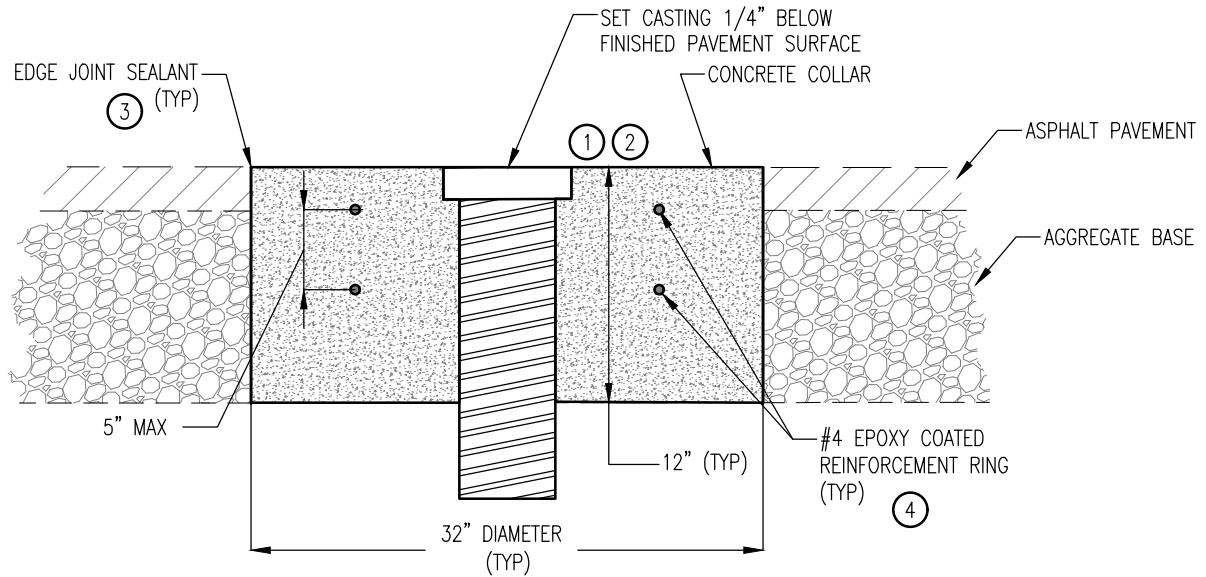
ANODE CONNECTION

W-18

REVISED/APPROVED 04/05/2019

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

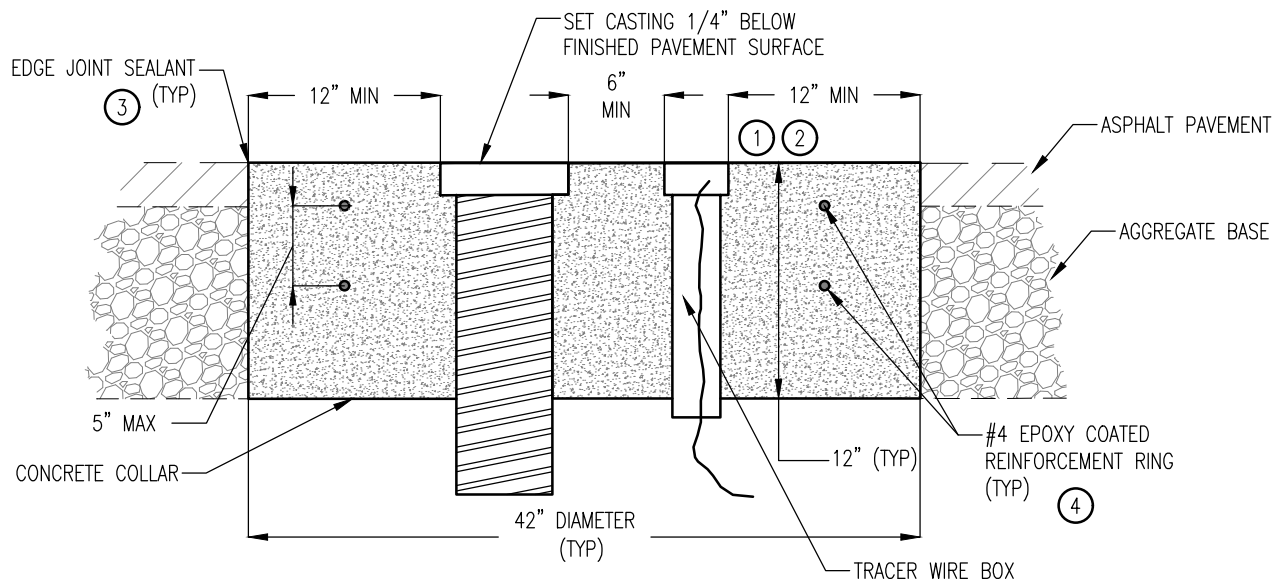
NO SCALE



NOTES:

- (1) CONCRETE (MIX NO. 3G52) COLLAR TO ENCASE VALVE BOX CASTING.
- (2) CONCRETE COLLAR SHALL BE CIRCULAR LAYOUT. PAVEMENT AND BASE SHALL BE CUT OUT WITH ROTATING CUTTING DEVICE
- (3) FINISH CONCRETE EDGE WITH 1/4" RADIUS. SEAL JOINT BETWEEN PAVEMENT AND COLLAR.
- (4) MAINTAIN 3.5" COVER ON REINFORCEMENT.

CONCRETE ENCASED WATER VALVE BOX COLLAR



**CONCRETE ENCASED WATER VALVE BOX COLLAR W/
TRACER BOX ALTERNATIVE**

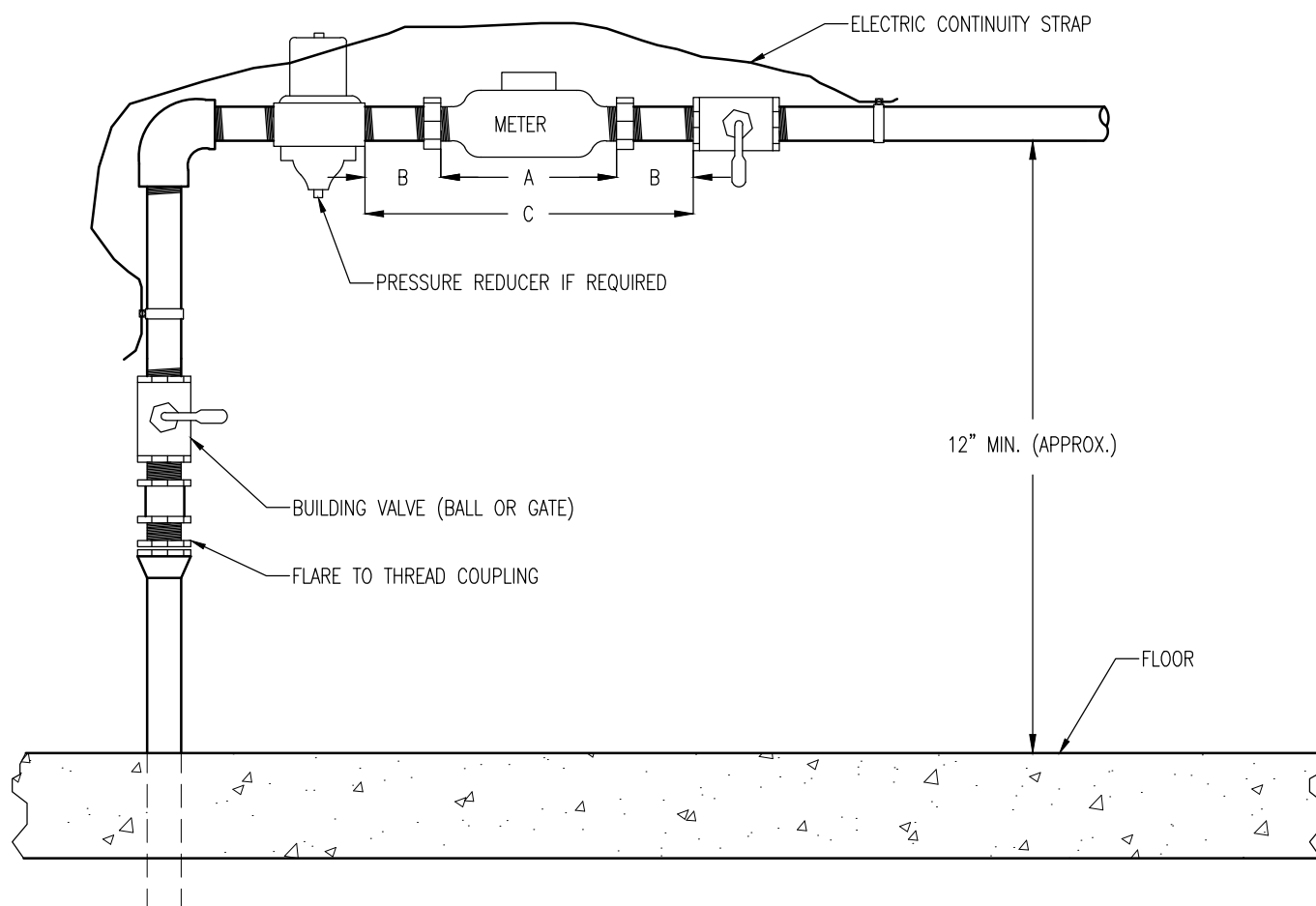
CONCRETE ENCASED VALVE BOX COLLAR IN ROADWAY

W-19

REVISED/APPROVED 01/20/2017

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



WATER METER SIZE					
	5/8"	3/4"	1"	1 1/2"	2"
A - METER LENGTH	7-1/2"	9"	10 3/4"	12-5/8"	15-1/4"
B - METER TAIL PIECE	2-3/8"	2-1/2"	2 5/8"	2-1/2"	2-5/8"
C - METER W/ TAIL PIECE	12-1/2"	14"	16"	17-5/8"	20-1/2"
TAIL PIECE THREAD SIZE	1/2"	3/4"	1"	2-1/4" X 1-3/4"	2-1/4" X 1-3/4"
MAX. METER OUTPUT (GPM)	25	35	70	120	170

NOTES:

1. SUPPLY PIPE AND FITTINGS BETWEEN BUILDING VALVE AND METER SHALL BE THREADED BRASS AND/OR COPPER AND NOT BE LESS THAN 3/4" SIZE.
2. METERS SHALL ALWAYS BE INSTALLED IN A HORIZONTAL POSITION.
3. VALVES SHALL BE GATE OR FULL-WAY BALL VALVES.
4. PRESSURE REDUCING VALVE IS REQUIRED WHERE PRESSURE EXCEEDS 80 PSI.
5. ELECTRICAL CONTINUITY STRAP IS REQUIRED EXCEPT WHERE BYPASS IS INSTALLED. SIZE OF STRAP BY ELECTRICAL CODE.

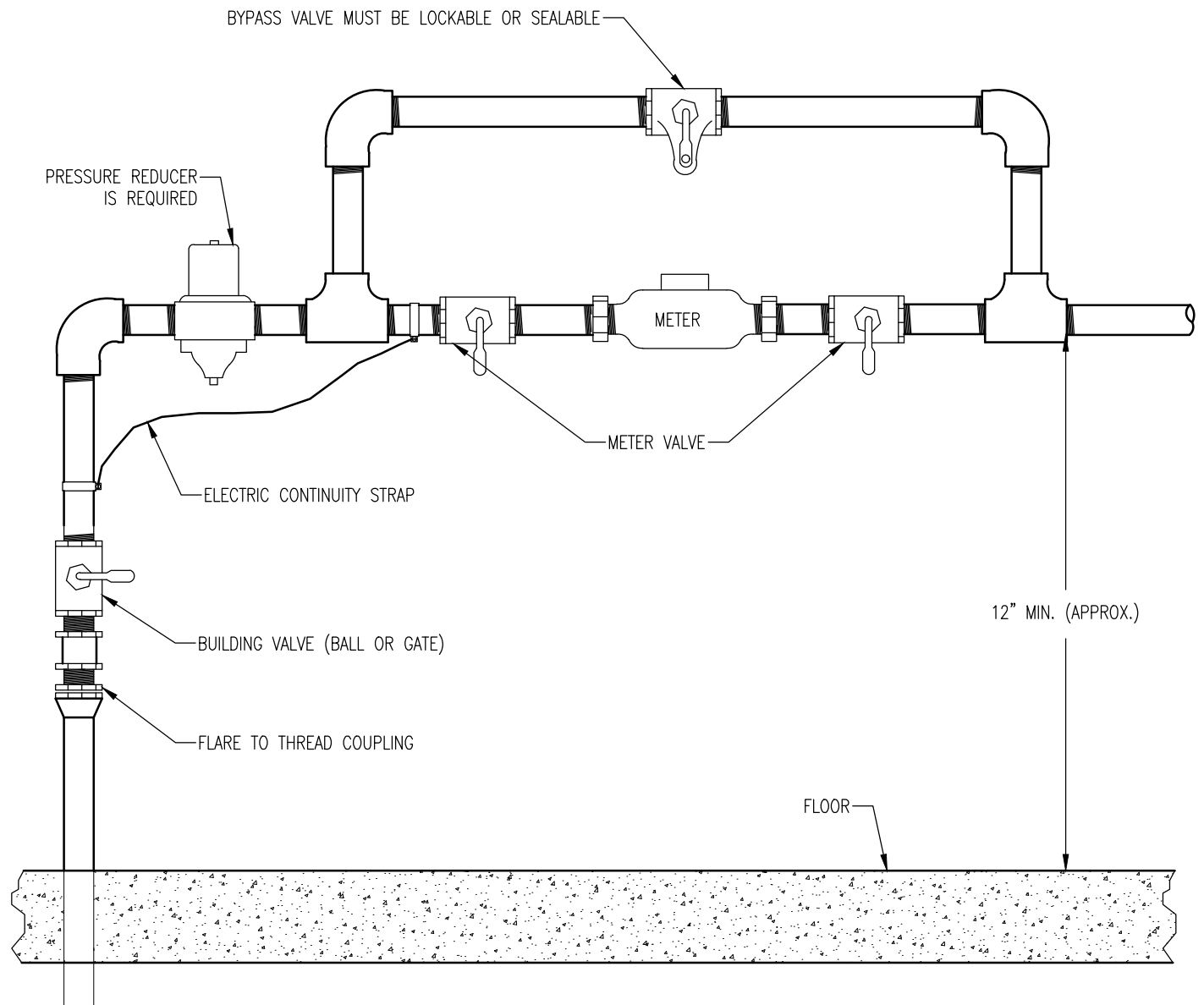
TYPICAL WATER METER INSTALLATION - SINGLE

W-30

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. SUPPLY PIPE AND FITTINGS BETWEEN BUILDING VALVE AND METER SHALL BE THREADED BRASS AND/OR COPPER AND NOT BE LESS THAN 3/4" SIZE
2. METERS SHALL ALWAYS BE INSTALLED IN A HORIZONTAL POSITION
3. VALVES SHALL BE GATE OR FULL-WAY BALL VALVES
4. PRESSURE REDUCING VALVE IS REQUIRED WHERE PRESSURE EXCEEDS 80 PSI
5. ELECTRICAL CONTINUITY STRAP IS REQUIRED EXCEPT WHERE BYPASS IS INSTALLED. SIZE OF STRAP BY ELECTRICAL CODE
6. BYPASS VALVE MUST BE LOCKABLE OR SEALABLE
7. METER INSTALLATIONS 2" OR LARGER MAY REQUIRE A BYPASS IF POTENTIAL HEALTH OR SAFETY RISKS INCREASE IF WATER SUPPLY IS INTERRUPTED

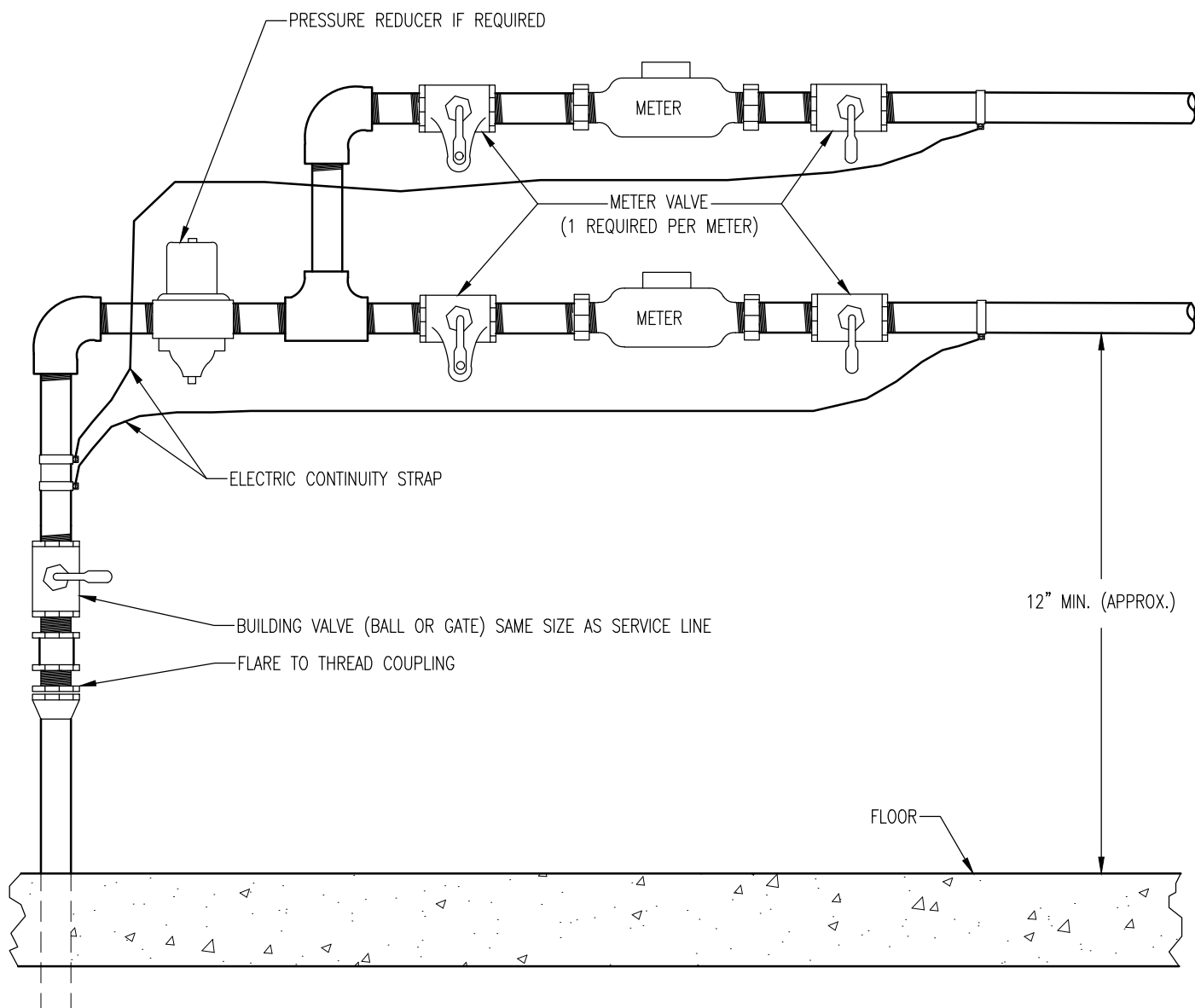
TYPICAL WATER METER INSTALLATION WITH BYPASS

W-31

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. SUPPLY PIPE AND FITTINGS BETWEEN BUILDING VALVE AND METER SHALL BE THREADED BRASS AND/OR COPPER AND NOT BE LESS THAN 3/4" SIZE
2. METERS SHALL ALWAYS BE INSTALLED IN A HORIZONTAL POSITION
3. VALVES SHALL BE GATE OR FULL-WAY BALL VALVES
4. PRESSURE REDUCING VALVE IS REQUIRED WHERE PRESSURE EXCEEDS 80 PSI
5. ELECTRICAL CONTINUITY STRAP IS REQUIRED EXCEPT WHERE BYPASS IS INSTALLED. SIZE OF STRAP BY ELECTRICAL CODE
6. FOR METERS 3" AND LARGER, A STRAINER IS REQUIRED AHEAD OF METER
7. UPSTREAM METER VALVE ON MULTIMETER INSTALLATIONS MUST BE LOCKABLE

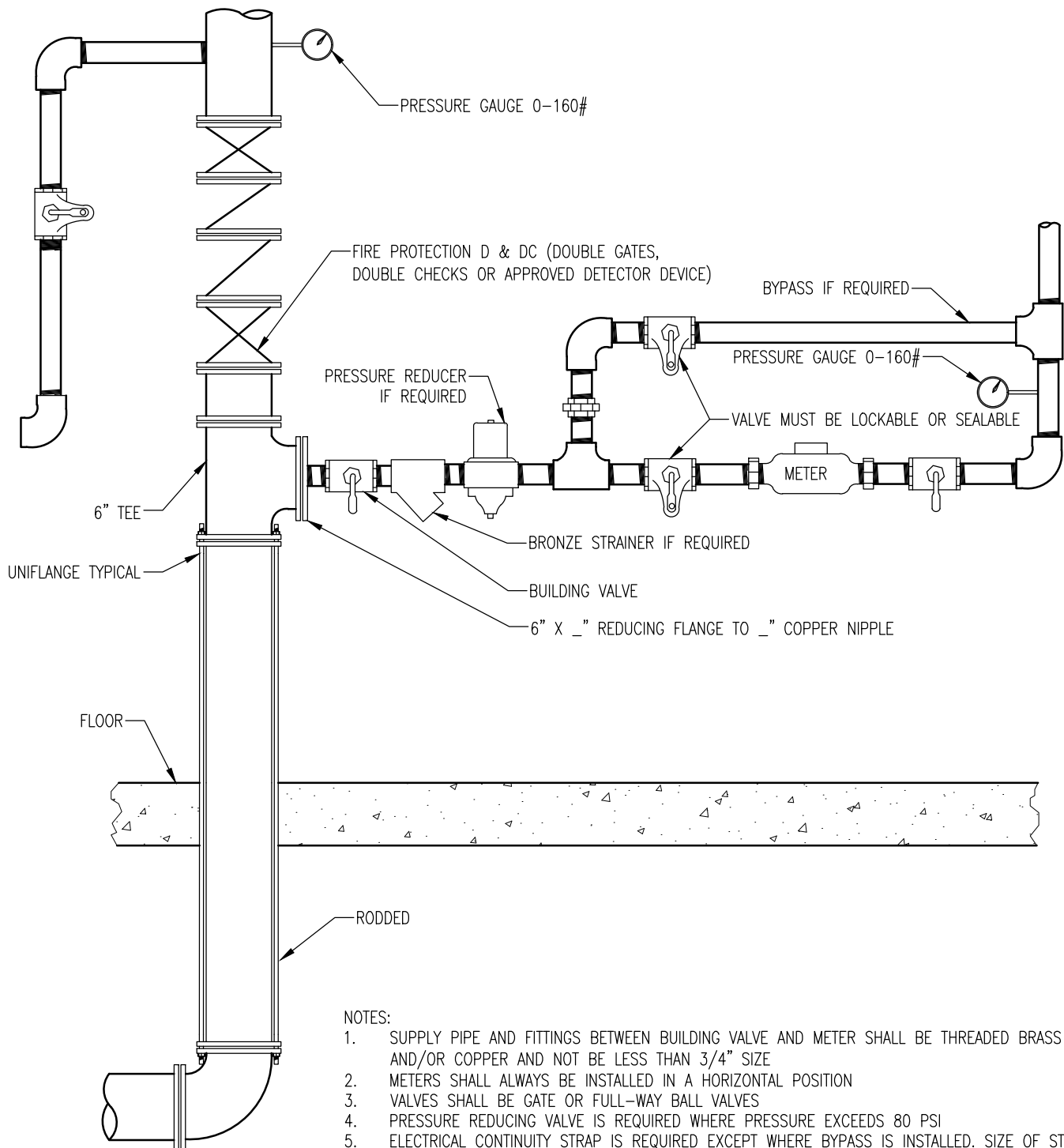
MULTIPLE WATER METER INSTALLATION

W-32

REVISED/APPROVED 02-01-2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



NOTES:

1. SUPPLY PIPE AND FITTINGS BETWEEN BUILDING VALVE AND METER SHALL BE THREADED BRASS AND/OR COPPER AND NOT BE LESS THAN 3/4" SIZE
2. METERS SHALL ALWAYS BE INSTALLED IN A HORIZONTAL POSITION
3. VALVES SHALL BE GATE OR FULL-WAY BALL VALVES
4. PRESSURE REDUCING VALVE IS REQUIRED WHERE PRESSURE EXCEEDS 80 PSI
5. ELECTRICAL CONTINUITY STRAP IS REQUIRED EXCEPT WHERE BYPASS IS INSTALLED. SIZE OF STRAP BY ELECTRICAL CODE
6. FOR METERS 3" AND LARGER, A STRAINER IS REQUIRED AHEAD OF METER
7. UPSTREAM METER VALVE ON MULTIMETER INSTALLATIONS MUST BE LOCKABLE
8. BYPASS VALVE MUST BE LOCKABLE OR SEALABLE
9. UPSTREAM METER VALVE ON DOMESTIC BRANCH OFF OF A FIRE SERVICE MUST BE LOCKABLE

TYPICAL 6" FIRE SERVICE WITH DOMESTIC WATER

W-34

REVISED/APPROVED 02/01/2013

CITY OF DULUTH STANDARD DETAIL
DEPT. OF PUBLIC WORKS AND UTILITIES

NO SCALE



City of Duluth, Minnesota

Public Works & Utilities Department - Engineering Division

Standard Construction Specifications - 2019 Edition

APPENDIX E

Supplemental Concrete Specifications

(Sections 2301, 2302, 2461, 2462, 2472, 3137)

S-1 (2301) CONCRETE PAVEMENT
REVISED 01/04/19
SP2018-124

MnDOT 2301 is hereby modified as follows:

S-1.1 Table 2301-4 of MnDOT 2301.2.L.1 shall be deleted and replaced with the following:

Table 2301-4 Concrete Mix Design Requirements												
Concrete Grade	Estimated Concrete Contract Quantity (yd³) *	Mix Number	Maximum w/c ratio		Minimum Cement Content (lbs/yd³)	Cementitious Content (lbs/ yd³)	Air Content %	Gradation Requirements	Minimum Aggregate Size Required	Maximum %SCM (Fly Ash/ Slag/ Ternary) †	Slump Range	3137 Spec
			Fly Ash	Slag/ Ternary								
A	≥ 3,500	3A21	0.40	0.42	385	530 – 615	7.0	Job Mix Formula	1 1/2” nominal	33/35/40	½ - 2” ‡	2.D.3
		3A41	0.40	0.42							2 – 5”	
	< 3,500 and Minor work and fill-ins not provided by the primary paving plant #	3A21S	0.42	0.42	385	530 – 615	7.0	3126 and Table 3137-4 Or Job Mix Formula	3/4” nominal	33/35/40	½ - 2” ‡	2.D.3
		3A41S	0.42	0.42							2 – 5”	
		3A42 §	0.42	0.42	385	530 – 615	7.0	3126 and Table 3137-4	3/4” nominal	33/35/40 §	2 – 5”	
	Engineer Approved or Plan Allowed High-Early	3A21HE **	0.40	0.42	385	> 615 – 750	7.0	3126 and Table 3137-4 Or Job Mix Formula	3/4” nominal	33/35/40	½ - 2” ‡	2.D.3
		3A41HE **	0.40	0.42							2 – 5”	
	* Determined by multiplying the planned pavement area by the planned pavement thickness. Provide additional cementitious material to meet requirements in accordance with this section at no additional cost to the Department. † Refer to Table 2301-2 and Table 2301-3 for ASR mitigation requirements. ‡ Adjust slump in accordance with 2301.3.E.1, “Consistency.” # The 5 th digit “S” indicate the concrete is for a small concrete paving project or delivered from a secondary concrete plant for minor work or fill-ins. The Concrete Engineer considers minor work or fill-ins as gaps in concrete pavement, turn lanes, intersections or other pavement sections as determined by the Engineer, in conjunction with the Concrete Engineer. § The Concrete Engineer will allow a non-project specific 3A42 mix design provided by a MnDOT certified ready-mix plant submitted in accordance with the first two paragraphs of 2461.2.F.3, “Submittal Requirements.” If the sand source requires mitigation with a minimum of 30% Class C fly ash in accordance with Table 2301-2, the Concrete Engineer will require a minimum of 30% Class C fly ash, 30% Class F fly ash or 35% slag for all 3A42 mixes. **The Contractor may use 100% Portland cement for High Early Concrete, provided no mitigation is required for the fine aggregate and intermediate aggregate in accordance with Table 2301-2 and coarse aggregate in accordance with Table 2301-3. If mitigation is required, the Contractor is required to use a minimum of 15% of any supplementary cementitious material when designing High Early Concrete.											

S-1.2 Add the following sentence to second paragraph of MnDOT 2301.2.L.2:

Always use the most current forms available from the MnDOT Concrete Engineering Website.

S-1.3 The third paragraph of MnDOT 2301.2.L.3.c and Table 2301-7 shall be deleted and replaced with the following:

If the gradation tests on any split sample from that day's testing result in a variation between the Producer and the Engineer greater than that set forth in Table 2301-7, the Engineer will substitute the Agency test results into the moving average calculation to determine acceptance and the well-graded aggregate optional incentive.

Table 2301-7	
Allowable Variations on Percent Passing Sieves	
Sieve Size	Allowed Percentage
2 in – 1 in	± 8
¾ in – ⅜ in	± 6
No. 4 – No. 30	± 4
No. 50	± 3
No. 100	± 2
No. 200	± 0.6

S-1.4 MnDOT 2301.2.M.2 and 2301.2.M.2.a shall be deleted and replaced with the following:

M.2 Water/Cement (w/c) Ratio

Provide and place concrete with a water/cement ratio not to exceed 0.40 when using cement only or fly ash and 0.42 when using slag or ternary. Make any adjustments immediately when the water/cement ratio exceeds 0.40 when using cement only or fly ash and 0.42 when using slag or ternary.

The Engineer will not make incentive payments for water/cement ratio on high-early mixes.

The Engineer will determine the water/cement ratio for concrete hauled in dump or agitator trucks (concrete hauled in truck mixers are not eligible for w/c ratio incentives) in accordance with the following:

M.2.a Sampling and Determination of Lots

The Engineer will sample, test, and record the individual results in accordance with 2301.2.M.2.b, "Water Content Determination," and 2301.2.M.2.c, "Cementitious Content Determination," at a rate defined in the Schedule of Materials Control. The Engineer will use the *W/C Ratio Calculation Workbook* for moisture testing and determining the incentive/disincentive.

The Engineer will base the statistical analysis of acceptance for water/cement ratio on a per lot basis representing one day's paving. Each individual water/cement ratio determination is considered a subplot. The lot will represent the cumulative average of the subplot values. The Engineer will start a new lot and test if either of the following occur:

- (1) Mix design change due to a water/cement ratio test result exceeding 0.40 when using cement only or fly ash and 0.42 when using slag or ternary, or
- (2) Supplementary cementitious type change from fly ash to slag or ternary mix design, or vice versa.

If the quantities of concrete produced results in no Engineer moisture testing for any given day, include the untested quantity of concrete into the next day's production and include that quantity of concrete in the sampling rate. If the untested quantity is on the last day of production, add that quantity to the previous day's production.

S-1.5 MnDOT 2301.2.M.2.e shall be deleted and replaced with the following:

M.2.e W/C Ratio Incentive/Disincentive

Do not place concrete mix not meeting the water/cement ratio requirements in accordance with Table 2301-4. The Engineer may accept inadvertently placed material not meeting the contract requirements in accordance with Table 2301-11.

Table 2301-11 W/C Ratio Incentive/Disincentive			
When using cement only or fly ash		When using slag or ternary	
W/C Ratio Lot Result	Payment incentive/disincentive per cu. yd	W/C Ratio Lot Result	Payment incentive/disincentive per cu. yd
≤ 0.37	+\$3.00	≤ 0.39	+\$3.00
0.38	+\$1.75	0.40	+\$1.75
0.39	+\$0.50	0.41	+\$0.50
0.40	\$0.00	0.42	\$0.00
0.41	-\$0.50	0.43	-\$0.50
0.42	-\$1.75	0.44	-\$1.75
≥ 0.43	Determined by the Concrete Engineer	≥ 0.45	Determined by the Concrete Engineer

The Contractor may remove and replace concrete represented by water/cement ratio results greater than 0.40 when using cement only or fly ash and 0.42 when using slag or ternary. If the Contractor elects to not remove the concrete and the level of payment is not defined in the Table 2301-11, the Engineer, in conjunction with the Concrete Engineer, will evaluate the concrete based on the adequacy for the use intended. Remove and replace unsatisfactory concrete as determined by the Engineer at no additional cost to the Department.

S-1.6 The first sentence of MnDOT 2301.2.M.3 shall be deleted and replaced with the following:

The Engineer will use the Contractor's combined aggregate gradation (JMF) test results (QC and Verification Companion) documented in the *JMF Concrete Aggregate Workbook*, as verified by the Engineer in accordance with 2301.2.L.3.c, "Agency Verification of JMF," to determine eligibility for the incentive.

S-1.7 Table 2301-12 shall be deleted and replaced with the following:

Table 2301-12 Well Graded Concrete Aggregate Gradation Band	
Sieve Size	% Retained
2 in	0%
1½ in	≤ 5%
1 in	≤ 16%
¾ in	≤ 20%
½ in	4 – 20%
⅜ in	4 – 20%
No. 4	4 – 20%
No. 8	≤ 12%

Table 2301-12 Well Graded Concrete Aggregate Gradation Band	
Sieve Size	% Retained
No. 16	≤ 12%
No. 30	4 – 20%
No. 50	4 – 20%
No. 100	≤ 10%
No. 200	≤ 2%
Coarse Sand % Retained (No. 8 to No. 30 Sieve)	> 15%
Fine Sand % Retained (No. 30 to No. 200 Sieve)	24% – 34%

S-1.8 MnDOT 2301.3.B.3.b shall be deleted and replaced with the following:

3.B.3.b Paving Plant Sampling and Testing

Provide the following personnel:

- (1) QC Plant Technician(s) to perform all testing and quality control requirements of 2301. The QC Plant Technician shall hold a current MnDOT Concrete Plant Certification.
- (2) Quality Control Supervisor responsible for oversight of all QC testing and daily paving batch plant operations. The Quality Control Supervisor shall hold a current MnDOT Concrete Plant Certification and is required to remain on-site during concrete production or have cellular phone availability.
- (3) Quality Control Manager responsible for oversight of the Quality Control Supervisor and all batch plant operations. The Quality Control Manager and Quality Control Supervisor can be the same person.

The Engineer will provide MnDOT Certified Concrete Plant Technician(s) to perform all testing in accordance with the requirements of 2301.

Perform testing in accordance with the Concrete Manual and determine testing rates in accordance with the requirements of the Schedule of Materials Control. The Engineer performs testing in accordance with the Concrete Manual and determines testing rates meeting the requirements of the Schedule of Materials Control.

S-1.9 MnDOT 2301.3.F.3.a(6) shall be deleted and replaced with the following:

- (6) Adhere the geotextile to the underlying substrate using manufacturer recommended cylinder spray adhesive for geotextiles to attach the geotextile to the underlying concrete or asphalt. Apply a minimum 12 in wide adhesive bond to attach any edge of geotextile to the underlying substrate or to another piece of geotextile. Apply pressure to the geotextile to set the adhesive prior to placing the concrete. The Contractor may propose and demonstrate alternate methods for satisfactorily anchoring the geotextile to the Engineer for approval.

S-1.10 The first paragraph of MnDOT 2301.3.F.5 shall be deleted and replaced with the following:

Use any approved construction header method as shown in the Standard Plate 1150 when constructing construction headers, temporary headers, and permanent headers as shown on the plans. The Contractor may propose and demonstrate alternate construction header methods to the Engineer for approval. In the plastic concrete, the Engineer may evaluate headers for vertical surface deviations with a 10 foot straight edge. Correct all high and low spots identified within the 10 foot straight edge.

S-1.11 MnDOT 2301.3.F.6.b(3) shall be deleted and replaced with the following:

F.6.b(3) Non-Conforming Air Content After Consolidation

If the Contractor or Engineer test results in an air content after consolidation of less than 4.5%, take the following action:

- (1) Immediately retest and verify the ACF is correct.
- (2) If the results are still < 4.5%, make immediate adjustments to the concrete or the consolidation process, test any loads that have not been discharged or adjusted at the plant and apply the ACF to determine compliance.
- (3) Test every load of concrete until the air content after consolidation test results are ≥ 4.5%.
- (4) Test at least 3 additional trucks to ensure the concrete remains in compliance.
- (5) Perform additional testing on the hardened concrete as required by the Engineer in conjunction with the Concrete Engineer.

S-1.12 MnDOT 2301.3.I.2(3) shall be deleted and replaced with the following:

- (3) 2301.3.L.2, "Contractor Quality Control Probing."

S-1.13 MnDOT 2301.3.K.1.a shall be modified to include the following:

- (4) For concrete roundabouts (not including the truck apron), perform a minimum of 3 texture tests

S-1.14 MnDOT 2301.3.K.1.b(3) shall be deleted and replaced with the following:

- (3) Run additional tests at 100 ft intervals before and after the failing test location until an acceptable minimum texture of 1.00 mm is obtained.

S-1.15 MnDOT 2301.4.B.1(4) shall be deleted and replaced with the following:

- (1) Apply incentives or disincentives based on the daily cubic yards batched of *Structural Concrete* as verified by the computerized batch ticket printouts from the plant, with consideration of any waste.

S-2 (2302) CONCRETE PAVEMENT REHABILITATION (CPR)

REVISED 01/25/19

SP2018-131

2302.1 DESCRIPTION

This work shall consist of performing concrete pavement repairs, load transfer restoration, and joint/crack sawing and sealing in accordance with the Concrete Pavement Rehabilitation (CPR) Standard details, and the following.

2302.2 MATERIALS

A Structural Concrete 2461

A.1 Partial Depth Repairs, Type B, Mix No. 3U18 3105

A.1.a Pre-bagged Grade 3U18 Concrete Patch Mix

Provide a dry, bagged MnDOT Grade 3U18 concrete patch mix, in accordance with 3105.

A.1.b Field-Proportioned Grade 3U18 Concrete Patch Mix

Provide Grade 3U18 concrete mix by mass in accordance with Table 2302-1.

Table 2302-1 Mix Proportions	
Material	Weight, lb.
Type I Cement	100
Coarse Aggregate, ASTM #89	159
Fine Aggregate	162

A.1.c Coarse Aggregate Gradation Requirements, ASTM #89 or CA-80

Provide either an ASTM #89 or CA-80 Gradation in accordance with Table 3137-4 for use in Grade 3U18 concrete patch mix or Dowel Bar Retrofit Repairs. Provide coarse aggregate meeting the quality requirements of 3137.2.D.3, “Coarse Aggregate for Concrete Pavement.”

A.2	Full Depth Repairs, Type C and Type CX, Mix No. 3R52 and 3RHE52	2461
B	Reinforcement Bars	3301
C	Dowel Bars Used in Dowel Bar Baskets	3302
C.1	Dowel Bars Used in Drill and Grout or Dowel Bar Retrofits Applications	3302.2.A
D	Curing Materials	
D.1	Poly-Alpha Methylstyrene (AMS) Membrane Curing Compound	3754
D.2	Linseed Oil Membrane Curing Compound	3755
D.3	Plastic Curing Blankets	3756
D.4	Insulation Board.....	3760
E	Joint Sealant	3725
F	Preformed Joint Filler	3702
G	Form Coating Material	3902
H	Dowel Bar Retrofit (DBR) Repair Materials	2302

H.1.a Approved Non-Shrink Rapid Set Concrete for Dowel Bar Retrofit Repairs

Provide a Packaged, Dry, Non-Shrink, and Rapid- Hardening Concrete Material for backfilling Dowel Bar Retrofits repairs from the MnDOT Approved/Qualified Product List.

The Engineer will allow on site addition (extension) of coarse aggregate in accordance with the following:

- (1) Limit coarse aggregate extension to same source/same percent mass extension as was utilized in the AMRL certified laboratory trial-batch testing.
- (2) Limit the coarse aggregate extension to the manufacturer’s recommended maximum or to a maximum of 50 percent by mass, whichever is less.
- (3) Meets aggregate quality requirements of Standard Specification 3137.2.D.3.

H.1.b DBR Project Submittal Requirements

At least 21 days prior to performing DBR repairs, submit the following information to the MnDOT Concrete Engineering Unit for review:

- (1) A concrete mix design including the coarse aggregate source at the proposed extension percentage.
- (2) A signed letter from the Rapid-Hardening Cementitious Material manufacturer stating the means and methods specified in both MnDOT Special Provision 2302 and outlined on the Dowel Bar Retrofit detail sheets are acceptable procedures.
- (3) Any field testing requirements recommended by the manufacturer of the Rapid-Hardening Cementitious Material.

The Engineer in conjunction with the Concrete Engineer will determine final acceptance of the DBR repair backfill material based on satisfactory field placement and performance, in accordance with 2302.3.F.4 "Test Section" and 2302.3.G "Repair Warranty."

H.2 End Caps

Provide tight fitting, nonmetallic non-organic end caps that will allow for a ¼ inch expansion movement of the dowel bar at each end.

H.3 Compressible Foam Board

Provide either a Type D-1 or D-2 preformed foam joint filler, in accordance with MnDOT Specification 3702 "Preformed Joint Filler." Provide foam joint filler that is at least 3/8 inch thick and is a minimum of 1/8 inch thicker than the joint / crack to ensure no leakage of patching material into the crack. Cut foam preformed joint filler to fit the full width and depth of the saw slot, as shown in the Dowel Bar Retrofit detail. The Engineer will not permit multiple pieces to obtain the proper height or width of the saw slot.

H.4 Dowel Bar Support Chairs

Provide two, nonmetallic support chairs that are either epoxy coated steel in accordance with ASTM A 884/A 884M or fabricated of commercial quality nonmetallic, non-organic material to support each dowel bar. The chairs when placed shall press securely against the slot face to firmly hold the dowels in the proper position while the backfill material is placed and consolidated.

H.5 Caulking Filler

Provide any commercial caulk that is designed as a crack sealant that is compatible with the proposed patching material. Use the caulking filler for sealing the existing joint or crack at the bottom and sides of the slot as shown in the Dowel Bar Retrofit detail. Do not extend/over band the caulk filler beyond the limits of the crack by greater than 1/2 inch.

2302.3 CONSTRUCTION REQUIREMENTS

A 3U18 Concrete Mixture Requirements for Partial Depth Repairs

Incorporate concrete into the concrete pavement rehabilitation repairs in accordance with Specification 2302, the Plan, Concrete Pavement Rehabilitation (CPR) Standard details, and the following.

Mix all dry pre-bagged grade 3U18 concrete patch mix on site, in a paddle type mixer for at least 5 minutes.

The Engineer may also allow batching by volume in a calibrated mobile type mixer to produce grade 3U18 concrete. Calibrate the mobile mixer to the weights shown in Table 2302-1. Proportion the cement, coarse and fine aggregate by volume (± 2.0 percent) in accordance with 2404.3.E.1, "Mixer Requirements" and 2461.3.D.2 "Batching by Volume."

Adjust water additions to achieve a maximum slump of 1 inch 5 minutes after batching concrete mix.

Do not accelerate concrete strength gain to facilitate early strength of pavement repairs solely for construction traffic unless approved by the Engineer.

If the Engineer approves the use of accelerating (Type C or E) admixtures, take extra precautions as necessary to ensure satisfactory finishing, curing, and protection of the concrete repairs. The Contractor assumes full responsibility for the performance of the concrete. The Engineer will determine final acceptance of the Type B repair concrete based on satisfactory field placement and performance, in accordance with 2302.3.G "Repair Warranty."

Refer to Table 2302-2, "MnDOT Mix 3U18 Opening Times", to determine the allowable mix adjustments to Grade 3U18 concrete. When anticipated time to opening for construction equipment or general traffic is less than 7 calendar days, and the ambient temperatures are anticipated to remain at or above 60°F during the curing time, provide approved admixture as outlined in Table 2302-2. The mix design will include the admixtures solution as part of the total recommended mixing water.

TABLE 2302-2 MnDOT Mix 3U18 Opening Times				
Anticipated Minimum Time to Opening *	Concrete Mix Grade	Admixture Dosage & Type Based on manufacturer's recommended dosage rate	Mix Design Responsibility	Testing and Strength Required for Opening
≥ 7 calendar days	3U18	None Required	2302	None *
72 hours to 7 calendar days	3U18	Type A ‡	2302	None *
36 hours to < 72 hours	3U18	Type A ‡	2302	Control Cylinders as per 2302.3.B.4(c) # π
12 hours to < 36 hours	3U18 †	As Needed §	2302	Control Cylinders as per 2302.3.B.4(c) # π
* If at any time the ambient temperature falls below 60°F during the curing time, use control specimens to determine opening times in accordance with 2302.3.B.4. The maximum slump for 3U18 mixes measured after 5 minutes is 1 inch. † Accelerating admixtures are not allowed when the ambient air temperature exceeds 80°F without the approval of the Concrete Engineer. ‡ Use manufacturer's recommended dosage rate to achieve 3000 psi minimum compressive strength or 500 psi flexural strength at the time of opening. # The Engineer may reduce the number of control specimens required based on previous control specimen strengths gains and site conditions. § Use a Type A, C or E admixture in accordance with 2302.3.A and the manufacturer's recommended dosage rate to achieve 3000 psi minimum compressive strength or 500 psi flexural strength at the time of opening. π Do not allow construction vehicles or general traffic on Type B repairs unless a minimum of 12 hours have elapsed and control cylinders achieve a minimum compressive strength of 3000 psi or 500 psi flexural strength.				

A.1 3R52 or 3RHE52 Concrete Mixture Requirements for (Type C) Full Depth Repairs

Provide a contractor designed concrete in accordance with Specification 2461, the Plan, Concrete Pavement Rehabilitation (CPR) Standard details, and the following.

Design either a concrete grade 3R52 or 3RHE52 for use in Type C Repairs in accordance with specification 2461 “Structural Concrete.”

Refer to Table 2302-3, “Mix 3R52 and 3RHE52 Opening Requirements,” to determine the criteria for opening 3R52 and 3RHE52 concrete to traffic.

Do **not** accelerate concrete strength gain to facilitate early strength of pavement repairs solely for construction traffic unless approved by the Engineer.

If the Engineer approves the use of accelerating (Type C or E) admixtures, take extra precautions as necessary to ensure satisfactory finishing, curing, and protection of the concrete repairs. The Contractor assumes full responsibility for the performance of the concrete. The Engineer will determine final acceptance of the Type C repair concrete based on satisfactory field placement and performance, in accordance with 2302.3.G. “Repair Warranty.”

TABLE 2302-3 Mix 3R52 and 3RHE52 Opening Requirements				
Anticipated Minimum Time to Opening *	Concrete Mix Grade	Admixture Dosage & Type Based on manufacturer’s recommended dosage rate	Mix Design Responsibility	Testing and Strength Required for Opening
≥ 7 calendar days	3R52	2461*	Contractor	None
< 7 calendar days to ≥ 12 hours	3R52 3RHE52	2461*	Contractor	Control Cylinders as per 2302.3.B.4(c) † ‡
* Accelerating admixtures are not allowed when the ambient air temperature exceeds 80°F without the approval of the Concrete Engineer. Use manufacturer’s recommended dosage rate to achieve 3000 psi minimum compressive strength or 500 psi flexural strength at the time of opening. † The Contractor may request to the Engineer a reduction in the number of control specimens required based on the results of the control specimen strengths and site conditions. ‡ Do not allow construction vehicles or general traffic on Type C repairs unless a minimum of 12 hours has elapsed and control cylinders achieve a minimum compressive strength of 3000 psi or 500 psi flexural strength.				

A.2 Placement Limitations

A.2.a Type A Repairs

- (1) Do not place joint sealant when the ambient temperature is below 40°F, nor when the joint faces show signs of frost or moisture.
- (2) Do not perform Type A repairs until the concrete grinding operations are completed.
- (3) If the pavement joints are widened, seal the joints before traffic is placed on the repairs.
- (4) Do not place joint sealant outside of the manufacturer’s temperature recommendations.

A.2.b Type B Repairs

- (1) Do not place concrete at ambient temperatures less than 50°F.
- (2) Do not place concrete when in-place pavement temperatures are below 50°F.
- (3) **Do not place any concrete mixture after October 15th.**

- (4) Do not place epoxy resin adhesive or non-shrink grout for bonding reinforcement bars to in place concrete outside of the manufacturer's temperature recommendations.
- (5) Do not use accelerating admixtures (Types C and E) when the ambient air temperature exceeds 80°F without the approval of the Concrete Engineer.

A.2.c Type C Repairs

- (1) The Engineer will consider all drill and grout dowels bars installed and anchored to the in place concrete pavement prior to performing the **Dowel Bar Anchoring Test Section (2302.3 E.5)**, as Unacceptable and Unauthorized Work, in accordance with Standard Specification 1512.
- (2) Place concrete in accordance with 2461 and 2302.3.B.3.c in these provisions.
- (3) Do not place any concrete mixture after October 15th, unless approved by Concrete Engineer, in conjunction with the Engineer, and an approved cold weather protection plan is in place.
- (4) Do not place epoxy resin adhesive or non-shrink grout for bonding reinforcement bars or dowel bars to in place concrete outside of the manufacturer's temperature recommendation.

A.2.d Dowel Bar Retrofits

- (1) Do not place pre-blended Non-Shrink Rapid Set Concrete Material when the pavement temperatures are above 90°F.
- (2) Maintain pre-blended Non-Shrink Rapid Set Concrete Material temperature at or below 90°F.

A.2.e Concrete Grinding

- (1) Do not grind the concrete unless the openings times and minimum strengths established in either Table 2302-2, Table 2302-3 or, 2302.3.B.5.a of these provisions have been met.
- (2) The Engineer will schedule a pre-grinding meeting at the project site. At the pre-grinding meeting, submit to the Engineer in writing the proposed Slurry Management Plan the grinding contractor will utilize to remain in conformance with Specification 1717. At the pre-grinding meeting, the Engineer and Contractor will review the site to identify the environmentally sensitive areas.

B General

Establish traffic control 1-day in advance of the beginning of the rehab operation for rehab surveys and locations.

B.1 Removals

Dispose of all removals outside the right of way in accordance with Specification 2104 to the satisfaction of the Engineer.

Repair any damage to any in-place pavement, roadway structure, joints, shoulders or appurtenance caused by the Contractor's operations as directed by the Engineer prior to final acceptance at no cost to the Department. Replace bituminous shoulder pavement, as directed by the Engineer, as an incidental cost to performing adjacent concrete repairs.

To prevent concrete pavement blow ups, saw full-depth relief cuts in the adjacent lanes and remove a transverse section 4 inches wide by full-width of the slab as the Contractor determines necessary to protect the existing concrete pavement. If the Contractor chooses not to saw a relief cut and damage is caused to the remaining concrete pavement, the Contractor shall make repairs as directed by the Engineer, at no cost to the Department. Prior to opening to traffic, backfill the void formed after concrete removal with Class 5 or other material as approved by the Engineer at no cost to the department. Maintain the backfill material flush within a tolerance of +/- 1/2 inch with adjacent concrete.

B.2 Placing and Finishing Concrete

Use concrete placing and finishing procedures that do not result in rounding of the surface at any joints or headers.

Reestablish longitudinal and transverse joints and cracks according to Joint Repair (Type A1) detail.

Tool rounded edges adjacent to all inserts and forms.

Limit overcutting into adjacent lanes to the nominal radius of the saw blade. At no cost to the Agency, seal overcuts into adjacent lanes in accordance with the Joint Repair Type A1 detail.

Assure that concrete repairs do not protrude beyond the original cross-section of the pavement by more than 3/8 inch by forming or sawing the edges.

Provide broomed surface texturing for skid resistance to all repairs, including when concrete grinding is to take place.

B.3 Concrete Curing and Protection

After completing final finishing operations, cure all exposed concrete surfaces. Use one of the following curing methods:

- (1.1) For Type B Repairs, place the membrane curing compound conforming to 3754 or 3755 within 10 minutes of concrete placement or once the bleed water has dissipated unless otherwise directed by the Engineer in accordance with 2302.3.B.3.a.1.
- (1.2) For Type C Repairs, place the membrane curing compound conforming to 3754 or 3755 within 30 minutes of concrete placement or once the bleed water has dissipated unless otherwise directed by the Engineer in accordance with 2302.3.B.3.a.1. Place the membrane-curing compound on the edges within 30 minutes after permanent removal of the forms or curing blankets unless otherwise specified in the Contract.
- (1.3) Place plastic curing blankets or completely saturated burlap curing blankets as soon as practical without marring the surface in accordance with 2302.3.B.3.a.2.

Whenever weather conditions are such as to cause unusual or adverse placing and finishing conditions or equipment failures occur, expedite the application of a curing method or temporarily suspend the mixing and placing operations, as the conditions require.

If necessary to remove the coverings to saw joints or perform other required work, remove the covering for the minimum time required to complete that work.

Failure to comply with the above provisions will result in the Engineer, in conjunction with the Concrete Engineer, applying a monetary deduction in accordance with 1503 and 1512 and the following:

- (2.1) For Type B Repairs, the Department will apply a monetary deduction of 100% of the unit bid price for the concrete in question.
- (2.2) For Type C Repairs, the Department will apply a monetary deduction of \$100.00 per cu. yd. or 50% of the Contractor-provided invoice amount for the concrete in question, whichever is less.

The Contractor may remove and replace the Type B or Type C Repairs at their own expense in lieu of the monetary deduction.

B.3.a Curing Methods

B.3.a.1 Membrane Curing Method

Before application, agitate the curing compound as received in the shipping container to obtain a homogenous mixture. Protect membrane-curing compounds from freezing before application. Handle and apply the membrane-curing compound in accordance with the manufacturer's recommendations.

Use an airless spraying machine for applying the curing compound on the concrete that complies with the following:

- (1.1) A re-circulating bypass system that provides for continuous agitation of the reservoir material,
- (1.2) Separate filters for the hose and nozzle, and
- (1.3) Multiple or adjustable nozzle system that provides for variable spray patterns.

Apply the curing compound in accordance with the following:

- (2.1) At a rate of 1 gal per 150 sq. ft of surface area.
- (2.2) Apply curing compound homogeneously to provide a uniform, solid, white opaque coverage on all exposed concrete surfaces (equal to a white sheet of typing paper). If using a Department - approved curing compound with a non-white base color, apply the compound to provide a uniform, solid, opaque consistency meeting the intent of the requirement in this section.
- (2.3) If the curing compound is damaged during the curing period, immediately repair the damaged area by re-spraying.
- (2.4) If the Engineer determines that the initial or corrective spraying result in unsatisfactory curing, the Engineer may require the Contractor to use the blanket curing method at no additional cost to the Department.

B.3.a.2 Blanket Curing Method

After completion of the finishing operations and without marring the concrete, cover the concrete with curing blankets. Install in a manner that envelops the exposed concrete and prevents loss of water vapor. After the concrete has cured, apply membrane curing compound to the concrete surfaces that will remain exposed in the completed work.

B.3.b Protection Against Rain

Protect the concrete from damage due to rain. Have available, near the site of the work, materials for protection of the edges and surface of concrete. Should any damage result, the Engineer will suspend operations until corrective action is taken and may subject the rain-damaged concrete to 1503 and 1512.

B.3.c Protection Against Cold Weather for Full Depth (Type C) Repairs

If the national weather service forecast for the construction area predicts air temperatures of 36 °F or less within the next 24 h and the Contractor wishes to place concrete, submit a cold weather protection plan.

Protect the concrete from damage including freezing due to cold weather. Should any damage result, the Engineer will suspend operations until corrective action is taken and may subject the damaged concrete to 1503 and 1512.

B.3.c.1 Cold Weather Protection Plan

Submit a proposed time schedule and Plans for cold weather protection of concrete in writing to the Engineer for acceptance that provides provisions for adequately protecting the concrete during placement and curing. Include a method of monitoring the concrete temperatures. Ensure concrete pavement repair temperatures remain above 32° F for the entire cure time as defined in 2302.3.B.4 (c). Do not place concrete until the Engineer accepts the Contractor's cold weather protection plans.

B.4 Opening to Construction Equipment and Traffic

The Engineer will not allow the Contractor to open concrete pavement repairs to construction equipment / vehicles, concrete grinding equipment, cleanup equipment or, public traffic unless one of the following requirements has occurred:

- (1) When MnDOT designed 3U18 concrete or Contractor designed 3R52 / 3RHE52 concrete attains a minimum age of 7 calendar days, **or**
- (2) When MnDOT designed 3U18 concrete attains a minimum age of 72 hours **and** the admixture type, dosage rate, and minimum ambient temperature requirements outlined in Table 2302-2 are met, **or**
- (3) MnDOT designed 3U18 concrete or Contractor designed 3R52 or 3RHE52 concrete attains a minimum age of 12 hours **and** control strength specimens obtain minimum compressive strength of 3000 psi, or minimum flexural strength of 500 psi.
- (4) For dowel bar retrofits repairs, reached a minimum age of 4 hours **and** control strength specimens obtain minimum flexural strength of 500 psi, or minimum compressive strength of 3000 psi.
- (5) For both (3) and (4) above, the Contractor will cast and cure the control specimens in accordance with 2461. The Engineer will test the control specimens in accordance with ASTM C39. If the Engineer is unable to test the control specimens the Contractor will test the control specimens in accordance with the following:
 - (5.1) Supply and operate (in the presence of the Engineer) a calibrated mechanical or hydraulic concrete cylinder testing machine, in accordance with ASTM C39;
 - (5.2) Perform testing at a distance no greater than 30 miles from the control specimen fabrication site; and
 - (5.3) At no additional cost to the Department.

When opening times are less than 3 days, provide the Engineer with a letter from the manufacturer stating the required minimum cure times of the Epoxy Resin Adhesive (ERA) or Non-Shrink Grout (NGS) used to anchor either the dowel bars or reinforcement bars comply with the early opening times. Do not open to construction equipment or traffic until the manufacturer's recommended minimum cure times are met.

Once one of the above conditions has been met, sweep the portion of the closed traffic lane with a power pick-up broom prior to opening. Use water to control dust at the discretion of the Engineer.

C Type A Repairs

Type A repairs include: Variable Width Joint Crack Repair / Joint Repair (Type A1) and Variable Width In place Joint or Crack Repair / Joint Repair (Type A2).

Saw and clean transverse and longitudinal joints or cracks as specified below, in preparations for sealing, seal joints or cracks.

C.1 Removals

When performing Variable Width Joint Crack Repair / Joint Repair (Type A1):

Remove the in place joint sealer if applicable. The Contractor may remove the in place joint sealer in conjunction with widening of the in place joint or crack.

Widen in place or newly constructed transverse or longitudinal joint or crack by saw cutting and to a depth shown on the Variable Width Joint Crack Repair / Joint Repair (Type A1) detail. Freshly saw both joint faces. Do not widen the in place joint or crack greater than 1/4 inch from its existing width.

When performing the Variable Width in Place Joint or Crack Repair / Joint Repair (Type A2):

Remove all of the existing joint seal material from the in place joint insofar as possible with ripping teeth, wire brush, sawing or other reasonable equipment to the satisfaction of the Engineer.

Do not use equipment that will cause spalling of the pavement surface.

C.2 Preparation

Thoroughly clean all joints and cracks by water flushing immediately after sawing.

After joint has dried, sandblast then air blast.

Assure that the joints or cracks are clean, dry, and free of all incompressible material before applying sealant.

C.3 Repair

Install a closed cell backer rod when joints or cracks are 1/4 inch or greater. Install backer rod of a diameter and to the depth shown on the Joint Repair (Type A) details.

Use a MnDOT Approved hot pour joint sealer meeting the requirements of Specification 3725.

Apply joint sealer in accordance with the Manufacturer's recommendations.

Fill joints or cracks to 1/16 inch below the pavement surface. Any overfilling of hot pour joint sealer will require removal and replacement by the Contractor at no cost to the Department.

D Type B Repairs

Type B Repairs include: Partial Depth Repair (Type BA), Partial Depth Repair Special (Type BE), and Joint and Crack Repair (Type B3).

Remove deteriorated concrete at designated (Type B) repair areas, reestablish joints and cracks, furnish, place, and cure 3U18 concrete to the original slope and grade, saw and seal reestablished joints.

D.1 Removals

The Engineer will not allow "Jackhammers" for partial depth concrete removals. Removal chipping hammers are limited to a maximum rated weight of 35 pounds.

Equip milling machines used for concrete removal with a device for stopping at preset depths to prevent damage to the dowel bars.

Remove the concrete surface and all deteriorated concrete in the designated repair areas to a minimum depth of 2 inches.

Do not damage the dowel bars during the removal process. Any damage is the responsibility of the Contractor.

Remove the concrete surface in the designated repair area by either of the following:

- (1) Milling transversely or longitudinally. Chip-out secondary spalling resulting from the contractor's removal operations at no cost to the Department.
- (2) Delineate the repair area by saw cuts and chipping back the saw cuts to a 30°- 60° angle.

D.2 Preparation

If dowel bar or reinforcement bars cross-sectional loss due to corrosion is slight, place duct tape over the dowel bar, or another bond breaking material approved by the Engineer. Cut or burn-off the bar if the dowel bars are misaligned, exhibit corrosion to a greater degree or if the end of the dowel is exposed. If this involves more than three adjacent dowels, remove and replace the entire joint with a Full Depth Repair (Type CD).

Sandblast then air blast Type B Repairs clean.

Drill and grout No.4 epoxy coated reinforcement bars for Partial Depth Repair Special (Type BE). Maintain a minimum of 1 in concrete cover around bar. Install additional drill and grout No.4 epoxy coated bars at 6 in center-to-center while maintaining the minimum concrete cover.

The installation of the preformed joint filler is required before concrete placement in order to reestablish the joint or crack within the repair and to prevent the infiltration of the concrete into the crack or joint that runs through the repair. Allowing concrete to infiltrate into the joint or crack may cause a compression failure.

In some instances (mainly when concrete is removed under dowel bars), the preformed joint filler will not completely plug the joint or crack within the repair. If this circumstance is encountered, remove a section of the dowel to allow the placement of the preformed joint filler or place clean concrete sand to fill the void below the joint filler.

The practice of using sand in places where joint filler installation is impractical may result in a reduced repair life and is meant to be used on an occasional basis. Therefore, the Engineer should make an early determination of the extent of this type of fix and may want to use a Full Depth Repair (Type CD) in lieu of the Crack and Joint Repair (Type B3). The practice of using sand in places where joint filler installation is impractical may result in a reduced repair life and is meant to be used on an occasional basis. Therefore, the Engineer should make an early determination of the extent of this type of fix and may want to use a Full Depth Repair (Type CD) in lieu of the Crack and Joint Repair (Type B3).

The Engineer may allow sawing for joint establishment when all of the following conditions exist:

- (1.1) Precautions are taken to prevent infiltration of concrete into underlying joint,
- (1.2) Depth of the entire Type B repair remains above dowel bars,
- (1.3) In order to prevent compression spalls, saw cut the entire depth of the Type B repair,
- (1.4) Green sawing takes place in a timely manner, to prevent random cracks, and
- (1.5) Green sawing does not produce excessive spalling.

The Engineer will not allow sawing for joint establishment if any of the following conditions exist:

- (2.1) Type B repair depth extends below the top of the dowel bars, or
- (2.2) Type B repair is used to repair a random crack.

D.2.a Application of Bonding Agent

The Contractor will choose a method for bonding the 3U18 mix to the in-place concrete in accordance with the following:

- (1) Bonding Grout/Slurry Method
 - (1.1) Provide and place bonding grout to the prepared concrete repair surface consisting of 2 parts of Type I or Type I/II portland cement and 1 part sand, mixed with sufficient water to form a slurry.
 - (1.2) Mix the grout mechanically and apply by brushing or scrubbing (with a stiff bristle broom) on to the in place concrete surface. After applying the grout/slurry, immediately backfill repair with concrete.
 - (1.3) If the bonding grout dries or whitens prior to backfilling, discontinue the concrete backfill operation. Re-sandblast the repair prior to reapply grout and concrete backfill.
 - (1.4) The life of the grout shall not exceed one hour.
- (2) Water Bonding Method
 - (2.1) Apply clean potable water to the sandblasted concrete surface to achieve a saturated condition prior to concrete (3U18) backfilling. Apply multiple applications of potable water as necessary to achieve a saturated condition.
 - (2.2) If standing water is visible within the limits Type B repair, discontinue concrete backfill operations.

- (2.3) In accordance with 2302.3.D.3, an application of slurry/grout is still required at the repair surface.

D.3 Repair

Furnish concrete (MnDOT Grade 3U18), mix, place, surface finish, apply broom texture, apply grout slurry, cure and, saw and seal.

Provide a repaired surface tolerance that does not vary by more than 1/8 inch from the existing pavement surface as measured with a straight edge placed over the repair. Replace or grind the repair as necessary to correct deficiencies.

After radius edging all inserts, final finishing and providing broomed surface texture; apply a heavy application of bonding grout/slurry at the surface interface (around the perimeter) of the Type B repair and the in place concrete pavement. Position the grout/slurry band so 1 inch is over the in place pavement and 3 inches is located over the newly placed repair.

Apply the concrete cure in accordance with 2302.3.B.3, and protect the concrete repair from damage.

Saw and seal reestablished joints and cracks within Type B repairs in accordance with the Variable Width Joint Crack Repair / Joint Repair (Type A1).

E Type C Repairs

Type C Repairs include: Full Depth Repair (Type CD-LV), Full Depth Repair (Type CD-HV), Pavement Replacement (Type CX), Full Depth Repair (Type CA-LV), Spot Full Depth Repair (Type C1-LV) and Utility Trench Full Depth Repair (Type C2).

All repairs with the designation LV are intended for use on non-state designated roadways only. The Full Depth Repair (Type C1-LV, Type C2-LV and CA-LV) are for use on projects with small quantity of repairs. Contact the Concrete Engineering Unit for recommendations.

Saw cut concrete full depth and perform full-depth concrete removal; restore and compact the grade; install reinforcement bars, dowel bars, or both; and furnish, place, finish, and cure concrete and saw and seal joints.

E.1 Removals

Saw cut the concrete pavement full depth.

Remove in place concrete pavement. Removal of the concrete pavement must take place within 48 hours of the full depth saw cutting, unless otherwise allowed by the Engineer.

Repair or replace any damage to the adjacent pavement that occurs during the removal process to the satisfaction of the Engineer and at no cost to the Department.

E.2 Preparation

Furnish and install 18 in x 1.25 inch diameter dowel bars in conformance with Specification 3302 and details, or when the Full Depth Repair is used in the longitudinal direction furnish and install 18 in No. 8 epoxy coated reinforcement bars, in lieu of the dowel bars, in conformance with Specification 3301 and details. Provide dowel bars or reinforcement bars that are free of dirt, grease, oil or other foreign material.

Use drill bit(s) 1/8 inch **or** greater than the nominal outside diameter of the dowel bar or epoxy coated reinforcing steel that are anchored to the in place concrete pavement.

Provide a drill assembly or gang drill assemblies capable of drilling straight and true holes, to the required penetrating depth, drilling at mid concrete pavement thickness, and to the tolerances shown below.

Install dowel bars in Full Depth Repair (Type CD-LV), Full Depth Repair (Type CD-HV) and if applicable the Spot Full Depth Repair (Type C1-LV) in accordance with the following tolerances:

- (1) The final placement of the dowel bars is 9 in into the face of the in place concrete slab,
- (2) Parallel to the top of the pavement within +/- 1/4 inch,
- (3) Parallel to the other dowel bars within +/- 1/8 inch, and
- (4) Parallel to the roadway centerline +/- 1/2 inch.

Place dowel bar baskets assemblies as outlined in the Pavement Replacement (Type CX) and Full Depth Repair (Type CA-LV) details.

Use either the Epoxy Resin Adhesive (ERA) or Non-Shrink Grout (NSG) Installation Method to anchor the dowel bars and reinforcement bars into the concrete. Clean and prep the drilled holes in accordance with adhesive manufacturer's recommendations.

Final approval of the methods used to anchor dowels or reinforcement bars is based on actual field performance as verified by random coring.

E.2.a Epoxy Resin Adhesive (ERA) Installation Method

From the approved products list furnish an ERA material with a stated application of anchoring dowel bars or reinforcement bars. Provide to the Engineer an installation data sheet from the manufacturer. The ERA will meet AASHTO M 235 Type IV (Load Bearing Applications), Grade 3 (Non-sagging consistency) and of a Class (Temperature Range) to match the pavement temperature at the time of application. ERA Class (Temperature Range) designations are as follows:

- (1) Class A, for use below 40°F.
- (2) Class B, for use between 40°F and 60°F.
- (3) Class C, for use above 60°F the highest allowable temperature to be defined by the manufacturer of the ERA.

When pavement temperatures are below 40°F use Class A, when pavement temperatures are between 40°F and 60°F use either Class A or B, when pavement temperatures are above 60°F use Class A, B or C.

ERA injection can be by either a mechanical caulking apparatus or a pneumatic injection system and have a nozzle capable of reaching and filling the back of the drill hole. In accordance with the manufacturer's recommendations, fill drill hole with adhesive and insert dowel or reinforcement bars.

E.2.b Non-Shrink Grout (NSG) Installation Method

From the approved products list furnish a NSG material with a stated application of anchoring horizontal dowel bars or reinforcement bars. Provide to the Engineer an installation data sheet from the manufacturer of NSG material.

Provide either self-contained grout capsule or pre bagged NSG utilizing an injection system capable of reaching and filling the back of the drill hole.

E.3 Prior to Concrete Placement

When placing concrete adjacent to in place concrete pavement joints, protect all ends of transverse joints to the satisfaction of the Engineer to prevent concrete mortar from infiltrating into the existing joints, resulting in compression spalls.

Do not remove any preformed joint filler used in the re-establishment of joints in Type C repairs, except by sawing or as allowed by the Engineer.

E.4 Repair

Furnish, place, finish, and cure concrete grades 3R52 or 3RHE52 for all Type C repairs.

In accordance with full depth repair details Types CD-HV, CD-LV, and CA-LV, furnish, and place transverse No. 4 epoxy coated reinforcing steel.

In accordance with the full depth repair detail Type C2-LV, furnish both transverse and longitudinal reinforcing steel.

In accordance with Pavement Replacement (Type CX) repair detail, drill and grout No. 4 by 18 in long epoxy coated reinforcing (tie) steel into the adjacent lane at a spacing of 30 in.

The Engineer will require corrective work on vertical surface deviations greater than 1/4 in within the span of the 10 ft straightedge in any direction. For corrected variations, the Engineer will accept deviations less than or equal to 1/4 in within the span of a 10 ft straightedge in any direction.

Restore contraction joints by green sawing to a depth of 1/3 of the pavement thickness.

In accordance with Joint Repair (Type A1) detail, prepare and seal all saw cuts and reestablished cracks.

E.5 Dowel Bar Anchoring Test Section

Provide a dowel bar anchoring test section consisting of a complete Full Depth Repair (Type CD) at a site directed by the Engineer at least one (1) day prior to startup of major Full Depth Repair (Type CD) operations. Perform the dowel bar anchoring test section as follows:

- (1.1) Saw cut and remove in place pavement to the dimensions shown on the Full Depth Repair (Type CD) detail.
- (1.2) In the test section drill and install either 6 or 11 dowels in accordance with appropriate Full Depth Repair (Type CD).
- (1.3) Use either an MnDOT approved Epoxy Resin Adhesive or Non-Shrink Grout as an adhesive to secure the dowel bars to the in place concrete pavement.
- (1.4) Cure the dowel bar anchoring adhesive at least 4 hours before coring.
- (1.5) DO NOT PLACE CONCRETE IN THE DOWEL BAR TEST SECTION.
- (1.6) The Engineer will identify and mark three (3) core locations on a single side of the Full Depth Repair (Type CD).
- (1.7) Take three (3) – 4 inch diameter full depth cores centered on the dowel and 1 inch from the sawed vertical face.

The Engineer in conjunction with the Concrete Engineer will determine if the anchoring of the dowels is acceptable. The Concrete Engineer considers the anchoring method acceptable if no air voids are greater than ¼ inch in any direction. All cores will become the property of the Engineer.

If the Engineer determines the anchoring of the dowels **is** acceptable:

- (2.1) The Engineer will notify the Contractor to begin production operations.
- (2.2) The Engineer's continued acceptance is based on satisfactory placement and performance.
- (2.3) Place a full depth saw cut offset 1 foot from the vertical face of the test section.
- (2.4) Completely remove the cored side of the dowel bar test section.
- (2.5) Drill and anchor a new set of dowels as shown on the Full Depth Repair (Type CD).
- (2.6) The Engineer will pay for the work in this paragraph at the unit bid price of Full Depth Repair (Type CD) and Pavement Replacement (Type CX).
- (2.7) The working days for the test section are built into the total Contract Time.

If the Engineer determines the anchoring of the dowels is **not** acceptable:

- (3.1) The Engineer will require the removal of the first test section.
- (3.2) The Engineer will require another test section at the contractor's expense.
- (3.3) The Engineer will not extend the contract time for the additional test section.

The Engineer will consider the work in this section as incidental to the unit bid price for Full Depth Repair (Type CD) and Pavement Replacement (Type CX).

Provide traffic control for the test section in accordance with “Temporary Traffic Control Zone Layouts” or as shown in the Plans.

E.6 Dowel Bar Anchoring Assurance

At the Engineer’s discretion, the Contractor will take additional cores to confirm consistent dowel bar or reinforcing steel anchoring. For each 1500 Lineal Feet of Full Depth Repair (Type CD), the Engineer will randomly choose two separate repairs and mark a dowel bars for an assurance core. The Engineer will review the cores to determine if the anchoring operations remain acceptable. If the dowel bars show air voids greater than that specified in 2302.3.E.5, take additional cores as directed by the Engineer to determine the severity.

The Engineer will suspend Full Depth Repair operations if dowel bars are anchored improperly. Operations will not resume until the Contractor has demonstrated to the Engineer that the problem which caused the air voids is corrected.

If the cores show proper anchoring, back fill core holes with concrete mix 3U18.

When the coring operations have shown no problems with the Contractor’s dowel bar anchoring operations, the Engineer may decrease the frequency to two (2) assurance cores for every 3000 lineal feet of Full Depth Repair (Type CD).

The Engineer will consider the work in this section as incidental to the unit bid price for Full Depth Repair (Type CD) and Pavement Replacement (Type CX).

F Dowel Bar Retrofit

Retrofit dowel bars in mainline joints and/or mid panel cracks as shown on the Plans. Perform Dowel Bar Retrofits only after all other repairs are completed on the joint or crack.

F.1 Removal

Schedule operations so that all concrete removed during any work shift is replaced with dowel bars and backfill material prior to the time the lane is re-opened to traffic.

Employ saws equipped with gang mounted diamond blades capable of cutting the required amount of slots in each wheel path simultaneously. Vacuum up and remove water and saw residue from the pavement surface. Skewed joints or cracks may require slots longer than that specified in the details. The Engineer will not provide compensation for the additional sawing or any component of the dowel bar retrofit beyond the limits shown on the detail required to ensure at least 7 inches of dowel bar is placed on each side of the joint or crack. Limit traffic to five (5) days on sawn slots prior to completing the retrofit operation. For smaller projects (100 bars or less), the Engineer may allow walk-behind saws instead of slot saws as long as a template is used to ensure the slot locations are within the tolerances specified on the Dowel Bar Retrofit detail and below.

Make two saw cuts in the pavement to outline the longitudinal sides of each dowel bar slot. Saw the slots to the depth and length that allows placing the dowel at mid-depth in the pavement slab. Place the slot saw cuts:

- (1) Parallel to the top of the pavement within +/- 1/4 inch,
- (2) Parallel to the other slots within +/- 1/8 inch, and
- (3) Parallel to the roadway **centerline** +/- 1/2 inch.

NOTE: Always measure dowel bar offsets from the roadway centerline.

Remove the concrete between the parallel saw cuts with a chipping hammer. Do not punch through the bottom of the slot or dislodge the pavement that is to remain in place. During concrete removal

operations, use a small brush hammer as necessary to produce a flat, level surface within the slot for placing the bar in the proper location. Dispose of the removal debris on a daily basis, unless otherwise approved by the Engineer.

F.2 Preparation

F.2.a Slot Cleaning and Preparation

Sufficiently clean the bottom of the slots with a chipping or brush hammer to allow the dowel bar assembly to sit parallel to the pavement surface.

If needed dry the slot before sandblasting with a high pressure air blasting heat lance.

Sandblast the vertical sides and bottom of the slot after the concrete removal operations to remove all loose debris and saw residue. Continue to sandblast until all the sawing residue is removed and the vertical sawed faces are rough to the touch. The Contractor may recommend alternative methods of roughening for approval by the Engineer. The Engineer will require additional sandblasting if the slots become wet from any source after initial sand and air blasting other than 2302.F.3.

Immediately before beginning sealing of the joint or crack inside the slot, further clean all exposed surfaces and cracks with a "moisture and oil free" high pressure air blasting of 150 psi minimum.

Protect traffic from sand and air blasting in a manner approved by the Engineer.

F.2.b Sealing Joints and Cracks in Slot

After sand and air blasting the slot, seal the bottom and sides of the crack with caulking material to keep the patching material from leaking into the joint or crack. Cure caulking material for a minimum of 2 hours or until tack free or according to the manufacturer's recommendations, whichever is longer, prior to placing the approved rapid set non-shrink concrete. The caulking filler shall not extend 1/2 inch beyond each side of the existing joint or crack. The Contractor may complete sealing of the cracks in conjunction with furnishing and installing the dowel assembly.

F.2.c Placing Dowel Assembly into Slot

Supply dowel bar chairs that provide a minimum of 1/2 in clearance between the bottom of the dowel and the bottom of the slot and with sufficient rigidity to hold the dowel bar in place during concrete placement and vibratory consolidation.

Furnish and install preformed joint filler in accordance with 2302.2.H.3, Dowel Bar Retrofit details, and the following:

- (1.1) Provide a round hole in the preformed joint filler the same nominal diameter as the specified dowel bar. Use a slightly larger hole when necessary to accommodate a skewed joint or crack.
- (1.2) Slots cut into the preformed joint filler to accommodate the dowel bar are not allowed.
- (1.3) Locate the hole to provide enough preformed joint filler below the dowel to extend to the bottom of the slot.
- (1.4) The preformed joint filler is required to remain centered over the joint or crack and tight to the bottom and edges of the slot during placement of the concrete. If the preformed joint filler shifts during construction operations or if a crack forms adjacent to the preformed joint filler, the Engineer will require removal and replacement of the dowel bar retrofit at the Contractor's expense.

Apply form release agent as a bond breaker on dowel bars **prior** to their placement in the slots.

Install dowel assembly that has the bond breaker applied and is fitted with the compressible foam core board material, the support chairs, and the 1/4 inch expansion caps on both ends into the slot in accordance with the following:

- (2.1) Parallel to the top of the pavement within +/- 1/4 inch,

- (2.2) Parallel to the other slots within +/- 1/8 inch,
- (2.3) Parallel to the roadway **centerline** +/- 1/2 inch
- NOTE: Measure dowel bar offsets from the roadway centerline**
- (2.4) Minimum of 1/2 inch clearance between the bottom of the dowel and the bottom of the slot.

F.3 Repair

Thoroughly moisten (with potable water) all surfaces of the slot immediately prior to filling with backfill material. The Engineer will not allow standing water in the slot.

Fill each prepared slot with an approved rapid set non-shrink concrete for dowel bar retrofit repairs. Ensure the compressible foam core board remains upright over the existing joint or crack during the backfill operation. Vibrate the rapid set non-shrink concrete with a small 1 inch diameter hand-held vibrator capable of thoroughly consolidating the concrete around the dowel bar and support chairs and without segregation.

Finish the concrete flush to within a tolerance of 1/16 inch above the adjacent concrete surface. When concrete grinding is part of the Contract, leave the surface of the backfill material 1/4 inch above the adjacent concrete surface.

Immediately after final finishing, coat concrete with a membrane curing compound in accordance with 2302.3.B.3.

F.4 Test Section

Provide a test section consisting of complete dowel bar retrofit at a site directed by the Engineer at least three (3) days prior to startup of major operations as follows:

- (1.1) Install 24 retrofit dowels in the test section.
- (1.2) The Engineer will identify and mark three (3) locations for coring.
- (1.3) Take three – 4 inch diameter full depth cores through the dowel bar retrofits at least 4 hours after completion of the test section.

The Engineer will determine if the retrofitting operation is acceptable.

If the Engineer allows the retrofitting operation to continue:

- (2.1) The Engineer will notify the Contractor to begin production operations.
- (2.2) The Engineer's continued acceptance is based on satisfactory placement and performance.
- (2.3) Completely remove and replace the dowel installation where the core samples were taken.
- (2.4) The Engineer will pay for the work in this paragraph at the unit bid price for Dowel Bar Retrofit.
- (2.5) The working days for the test section are built into the total Contract Time.

If approval of the retrofitting operation is not given:

- (3.1) The Engineer will require the removal of the first test section.
- (3.2) The Engineer will require another test section.
- (3.3) The Engineer will not extend the contract time for the additional test section.

Provide traffic control for the test section in accordance with "Temporary Traffic Control Zone Layouts" or as shown in the Plans.

The Engineer will consider the work in this section as incidental to the unit bid price for Dowel Bar Retrofit.

F.5 Opening to traffic

The Engineer will not permit traffic by the public or Contractor on the newly placed concrete patching material until adequate strength is achieved, according to the manufacturer's recommendations or 3000 psi whichever is greater.

F.6 Retrofit Dowel Bar Placement Alignment Assurance

At the Engineer's discretion, the Contractor will take additional cores to confirm consistent dowel placement and proper consolidation for each 600 bars placed. The Engineer will randomly mark two retrofit locations for assurance coring. The Engineer will review the cores to determine if the retrofitting operation is acceptable. If the dowels are located incorrectly or air voids exist around the dowel bars, take additional cores, as directed by the Engineer, to determine the severity.

The Engineer will suspend dowel retrofitting operations if dowels are installed improperly. Dowel retrofitting operations will not resume until the contractor has demonstrated to the Engineer that the problem which caused the improper dowel positions or air voids is corrected. Replace any individual Dowel Bar Retrofit not functioning or damaged at the expense of the Contractor.

The Engineer will not allow water from the coring operation to flow across lanes occupied by public traffic or flow into closed drainage facilities.

After removal of the cores, completely remove and replace the dowel installation where the core samples were taken.

When the coring operations have shown no problems with the Contractor's placement operations, the Engineer may decrease the frequency of assurance cores to every 1200 bars placed or more at the discretion of the Concrete Engineer.

Provide traffic control for the coring in accordance with "Temporary Traffic Control Zone Layouts" or as shown in the Plans.

The Engineer will consider the work in this section as incidental to the unit bid price for dowel bar retrofit.

G Repair Warranty

Remove and replace areas of failure that appear within thirty (30) calendar days at no cost to the Department. The 30 calendar day warranty will commence after all Type B, Type C, Dowel Bar Retrofits repair **and** Concrete Grinding (when required) are completed in a single traffic lane. The continuity of a single traffic lane is not broken by either staging or project exceptions unless otherwise authorized by the Engineer. Any subsequent warranty repairs are subject to the 30 calendar day specification at no cost to the Department.

Failures include (but are not limited to) the loss of bonding to the in place concrete or crack apparent in the repair other than the desired crack in the newly constructed joint or re-established crack.

Supply traffic control as requested by the Department for inspection of repairs within the 30 calendar day warranty period and for the removal and replacement of repair failures.

2302.4 METHOD OF MEASUREMENT

The Engineer will:

- (A) **Not** measure extra width to accommodate the Contractor's equipment. Any extra width to accommodate the Contractor's equipment is at the Contractor's expense.
- (B) Measure Variable Width Joint or Crack Repair / Joint Repair (Type A1) by the lineal length. The Engineer will not take separate measurements for varying widths. The Engineer will **not** measure and pay the restoration of joints and cracks through or alongside any Type B, Type C or Dowel Bar Retrofit repairs under this item.

- (C) Measure Variable Width In Place Joint or Crack Repair / Joint Repair (Type A2) by the lineal length. The Engineer will not take separate measurements for varying widths.
- (D) Measure Partial Depth Repair (Type BA) by the actual area of the repair. Take the measurements for the area calculations at the pavement surface; include the 30 to 60 degree tapers in the measurements for the area calculations.
- (E) Measure Joint and Crack repair (Type B3) by the lineal length. The Engineer will take additional measurements for payment under this or other Type B repairs only when the following requirement are met:
 - (1) In isolated areas the typical width of the repair is exceeded **and** the measured quantity is equal to or greater than 1 square foot. This is not a cumulative quantity within a single Type B3 repair.
 - (2) A full width pass with the mill is taken on both sides of the joint or crack as directed by the Engineer.
 - (3) The Type B3 repair is placed on only one side of the joint or crack, and the opposite side of the joint or crack requires an additional repair when directed by the Engineer, regardless of the size of the repair preformed.
- (F) Measure Partial Depth Repair Special (Type BE) by the area of the repair. Take the measurements for the Partial Depth Repair Special (Type BE) area calculation at mid depth of the concrete pavement. Pay in conjunction with the Partial Depth Repair (Type BA) or Joint and Crack repair (Type B3). The Engineer will take measurements for the Partial Depth Repair Special (Type BE) only when the following requirements are met:
 - (1) When the in place concrete pavement is removed full depth, when the grade below the concrete pavement is visible and
 - (2) When reinforcement bars are furnished and installed as shown in Partial Depth Repair Special (Type BE) detail and at least one reinforcement bar is installed per unit of measure.

When the above requirements are not met the Engineer will only take measurements for payment on the Partial Depth Repair (Type BA) or Joint and Crack repair (Type B3) regardless of the depth of the repair.
- (G) Provide measurement for payment for overlapping Type BA and Type B3 repairs for the most expensive repair only.
- (H) Measure the Full Depth Repair (Type CD) by the lineal width. Take a single lineal measurement of the repair at a right angle from the standard dimension of 4 feet as shown on the Full Depth Repair (Type CD) detail. Unless the repair is placed at a skew to the roadway center line, then take the single lineal measurement along the skewed saw cut.
- (I) Measure the Pavement Replacement (Type CX) by the area of the repair. Pay Pavement Replacement (Type CX) in conjunction with the Full Depth Repair (Type CD) or the Full Depth Repair (Type CA-LV). When the standard dimension of 4.0 feet as outlined on the Full Depth Repair (Type CD) or Full Depth Repair (Type CA-LV) detail is exceeded, measure the area that is outside the 4.0 feet dimension as Pavement Replacement (Type CX).
- (J) Measure the Spot Full Depth Repair (Type C1-LV) by area of the repair.
- (K) Measure the Utility Trench Full Depth Repair (Type C2-LV) by area of the repair.
- (L) Measure the Full Depth Repair (Type CA-LV) by the lineal width. Take a single lineal measurement of the repair at a right angle from the standard dimension of 4 feet as shown on the

Full Depth Repair (Type CA-LV) detail. Unless the repair is placed at a skew to the roadway centerline, then take the single lineal measurement along the skewed saw cut.

- (M) Measure individual Dowel Bars per each, as supplied in dowel bar basket assemblies for Pavement Replacement (Type CX) repairs.
- (N) Measure Drill and Grout Reinforcement bars per each, as furnished and installed as tie bars for Pavement Replacement (Type CX) of 75 feet or greater in length.
- (O) Measure Dowel Bar Retrofit per each dowel bar successfully installed.
- (P) Measure Supplemental Reinforcement (Epoxy Coated) used for supplemental pavement reinforcement by mass.

2302.5

BASIS OF PAYMENT

The Engineer will pay for the various types of pavement, crack, joint and surface repairs in accordance with the schedule set forth below at the corresponding Contract unit bid price for each separate item of work. Which is compensation in full for costs of all materials, equipment, and labor required to complete the work as specified in the repair detail, to the satisfaction of the Engineer. Concrete mixes are considered incidental to the work in which they are incorporated.

- (A) Payment for Variable Width Joint or Crack Repair / Joint Repair (Type A1) at the contract price per unit of measure is full compensation for all cost including but not limited to the cost of removing and disposing of the in place joint sealer, sawing cutting both faces of the joint or crack to the proper depth and width, cleaning, sandblasting. Furnishing and installing backer rod of the proper size and to the proper depth. Furnishing and installing (hot poured) Joint and Crack Sealer (3725). Cleanup, and any other materials, labor, or equipment necessary to complete the work as specified.
- (B) Payment for Variable Width In Place Joint or Crack Repair / Joint Repair (Type A2) at the contract price per unit of measure is full compensation for all cost including but not limited to: Removing of the in place joint sealer, cleaning, sandblasting, furnishing and installing backer rod of the proper size and to the proper depth. Furnishing and installing (hot poured) Joint and Crack Sealer (3725). Cleanup, and any other materials, labor, or equipment necessary to complete the work as specified.
- (C) Payment for Partial Depth Repair (Type BA) at the contract price per unit of measure is full compensation for all cost including but not limited to: Removing and disposing of the in place concrete pavement as marked by the Engineer, tapering the edges of the repair back at 30 to 60 degrees, cleaning, sandblasting and air blasting, furnishing and installing bonding grout, furnishing and installing preformed joint filler to reestablish the joint or crack within or along the repair. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, placing cement and sand slurry around the edges, curing and protecting the concrete. Sawing and sealing reestablished joints and cracks in accordance with the Joint Repair (Type A1) detail. Cleanup, and any other materials, labor, or equipment necessary to complete the work as specified.
- (D) Payment for Joint and Crack repair (Type B3) at the contract price per unit of measure is full compensation for all cost including but not limited to: Removing and disposing of the in place concrete pavement as marked by the Engineer, tapering the edges of the repair back at 30 to 60 degrees, cleaning and sandblasting, furnishing and installing preformed joint filler to reestablish the joint or crack within or along the repair, furnishing and installing bonding grout. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, placing cement and sand slurry around the edges, curing and protecting the concrete. Sawing and sealing reestablished joints and cracks in accordance with the Joint Repair (Type A1) detail. Cleanup and any other materials, labor, or equipment necessary to complete the work as specified.

- (E) Payment for Partial Depth Repair Special (Type BE) at the contract price per unit of measure is full compensation for all cost including but not limited to: Removing and disposing of the in place concrete pavement as marked by the Engineer, cleaning, sandblasting and air blasting, furnishing and grouting reinforcement bars (epoxy coated), furnishing and installing bonding grout, furnishing and installing preformed joint filler to reestablish the joint or crack within or along the repair. Furnishing and placing concrete within the repair and vibrating.
- (F) If after removal the Engineer changes the initial Partial Depth Repair (Type BA) or Joint and Crack Repair (Type B3) to a Full Depth Repair (Type CD), the Department will pay the Contractor at a measured quantity of 40% of the Type B repair item plus the full cost for the Type C repair.
- (G) Payment for full Depth Repair (Type CD) at the contract price per unit of measure is full compensation for all cost including but not limited to: Saw cutting the pavement full depth, removal and disposal of the in place pavement, restoring and compacting the base, furnishing and installing preformed joint filler, furnishing, drilling and anchoring dowel bars, coring both the dowel bar anchoring test section and the random assurance cores, and backfilling the assurance core holes with concrete mix 3U18. If the repair is used in the longitudinal direction, furnishing, drilling and anchoring reinforcement bars in lieu of dowel bars. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, curing and protecting the concrete. Sawing and sealing reestablished joints, cracks and saw cuts in accordance with the Joint Repair (Type A1) detail. Cleanup and any other materials, labor, or equipment necessary to complete the work as specified.
- (H) Payment for Pavement Replacement (Type CX) at the contract price per unit of measure is full compensation for all cost including but not limited to: Saw cutting the pavement full depth, removing and disposal of the in place pavement, restoring and compacting the base, furnishing and installing preformed joint filler. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, curing and protecting the concrete. Sawing and sealing reestablished crack, joints and saw cuts in accordance with the Joint Repair (Type A1) repair detail. Cleanup and any other materials, labor, or equipment necessary to complete the work as specified.
- (I) Payment for Spot Full Depth Repair (Type C1-LV) at the contract price per unit of measure is full compensation for all cost including but not limited to: Saw cutting the pavement full depth, removal and disposal of the in place pavement, restoring and compacting the base, furnishing and installing preformed joint filler, furnishing, drilling and grouting dowel bars, epoxy coated reinforcement bars or both. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, curing and protecting the concrete. Sawing and sealing reestablished joints, cracks and saw cuts in accordance with the Joint Repair (Type A1) detail. Cleanup and any other materials, labor, or equipment necessary to complete the work as specified.
- (J) Payment for Utility Trench Full Depth Repair (Type C2-LV) at the contract price per unit of measure is full compensation for all cost including but not limited to: Saw cutting the pavement full depth, removal and disposal of the in place pavement, restoring and compacting the base. Furnishing and installing preformed joint filler, furnishing, drilling and grouting epoxy coated reinforcement bars. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, curing and protecting the concrete. Sawing and sealing reestablished joints, cracks and saw cuts in accordance with the Joint Repair (Type A1) detail. Cleanup, and any other materials, labor, or equipment necessary to complete the work as specified.
- (K) Payment for Full Depth Repair (Type CA-LV) at the contract price per unit of measure is full compensation for all cost including but not limited to: Saw cutting the pavement full depth, removal and disposal of the in place pavement, restoring and compacting the base, furnishing and

installing preformed joint filler and dowel bar baskets assemblies, drilling and grouting reinforcement bars. Furnishing and placing concrete within the repair, vibrating, screeding, finishing, applying surface texture, curing and protecting the concrete. Sawing and sealing reestablished joints, cracks and saw cuts in accordance with the Joint Repair (Type A1) detail. Cleanup, and any other materials, labor, or equipment necessary to complete the work as specified.

- (L) Payment for Drill and Grout Reinforcement Bars at the contract price per unit of measure is full compensation for all cost including but not limited to, drilling concrete and furnishing reinforcement bars (epoxy coated) and installing reinforcement bars with an approved grout or epoxy bonding agent.
- (M) Payment for Dowel Bar Retrofit at the contract price per unit of measure is full compensation for all cost including but not limited to: Sawing the slot, removal of the concrete within the slot, removing and vacuuming debris, sandblasting and air blasting, sealing the crack inside of the slot, the dowel bar and expansion caps, chairs, release agent, preformed joint filler or cardboard material. Furnishing and placing non-shrink rapid setting concrete mixture, finishing, curing and protecting the concrete. Sawing and sealing reestablished joints and cracks in accordance with the Joint Repair (Type A1) detail. Cleanup, and any other materials, labor, or equipment necessary to complete the work as specified.
- (N) Payment for Supplemental Reinforcement Bars (Epoxy Coated) at the contract price per unit of measure is full compensation for all cost including but not limited to, furnishing and installing reinforcement bars (Epoxy Coated) as specified.
- (O) Payment for Dowel Bars at the contract price per unit of measure is full compensation for all cost including but not limited to, furnishing and installing dowel bars in dowel bar baskets assemblies.
- (P) The Engineer will modify the provisions of MnDOT 1907 to the extent that when the actual usage of joint sealer material is less than specified, the surplus material shall remain the property of the Contractor. The Contractor is paid 15% of the material cost in lieu of handling and transportation costs, unless otherwise directed by the Engineer.

Item No.	Item	Unit
2302.602	Dowel Bar Retrofit	each
2302.602	Dowel Bar	each
2302.602	Drill and Grout Reinforcement Bar (Epoxy Coated)	each
2302.603	Joint Repair (Type A1)	linear foot
2302.603	Joint Repair (Type A2)	linear foot
2302.603	Joint and Crack Repair (Type B3)	linear foot
2302.603	Full Depth Repair (Type CA-LV)	linear foot
2302.603	Full Depth Repair (Type CD-LV)	linear foot
2302.603	Full Depth Repair (Type CD-HV)	linear foot
2302.604	Pavement Replacement (Type CX)	square yard
2302.604	Utility Trench Full Depth Repair (Type C2-LV)	square yard
2302.608	Supplemental Reinforcement Bars (Epoxy Coated)	pound
2302.618	Partial Depth Repair (Type BA)	square foot
2302.618	Partial Depth Repair Special (Type BE)	square foot
2302.618	Spot Full Depth Repair (Type C1-LV)	square foot

S-3 (2461) STRUCTURAL CONCRETE
REVISED 01/04/19
SP2018-156

MnDOT 2461 is modified as follows:

S-3.1 MnDOT 2461.2.F.1.c shall be deleted and replaced with the following:

F.1.c Slump Designation

The Department will designate the maximum slump as defined by the Grade Designation in accordance with Table 2461-6 and Table 2461-7.

S-3.2 Table 2461-3 of MnDOT 2461.2.F.1.d shall be deleted and replaced with the following:

Table 2461-3	
Coarse Aggregate Gradation Designation for Concrete	
Designation	Coarse Aggregate Gradation
1	2301, Concrete Pavement Only
Table 3137-4, "Coarse Aggregate Designation for Concrete"	
2	ASTM #67
3	ASTM #7
4	ASTM #89
7	CA-70
8	CA-80

S-3.3 Table 2461-6 of MnDOT 2461.2.F.2.b(1) shall be deleted and replaced with the following:

Table 2461-6 Concrete Mix Design Requirements (Not applicable to Mass Concrete)									
Concrete Grade	OLD Mix Number	NEW Mix Number	Intended Use *	Maximum w/c ratio 	Maximum Cementitious Content (lbs/yd ³)	Maximum %SCM (Fly Ash/Slag/Ternary)	Slump Range	Minimum 28-day Compressive Strength, f'c	3137 Spec.
B Bridge Substructure	3Y43	3B52	Abutment, stems, wingwalls, paving brackets, pier columns and caps, pier struts	0.45	750	30/35/40	2 - 5"	4000 psi	2.D.1
F Flatwork	3A22 3Y22	3F32	Curb and gutter	0.42	750	30/35/0	½ - 3" #	4500 psi	2.D.1
	3A32 3Y32 3A34	3F52 3F57EX † 3F52CO ‡	Sidewalk, curb and gutter, slope paving, median sidewalk, driveway entrances, ADA pedestrian sidewalk	0.45	750	25/30/0	2 - 5"	4500 psi	2.D.1
	1A43	1G52	Footings and pilecap	0.55	750	30/35/40	2 - 5"	4500 psi	2.D.1
G General Concrete	3A43 3B42 3Y43	3G52	Footings, pilecap, walls, cast-in-place manholes and catch basins, fence posts, signal bases, light pole foundations, erosion control structures, cast-in-place box culverts, culvert headwalls, open flumes, cast-in-place wall stems	0.45	750	30/35/40	2 - 5"	4500 psi	2.D.1
	3Y12	3M12	Slipform barrier, Median barrier, non-bridge	0.42	750	30/35/40	½ - 1" #	4500 psi	2.D.1
M Median Barrier	3Y32	3M52	Barrier, Median barrier, non-bridge	0.45	750	30/35/40	2 - 5"	4500 psi	2.D.1
P Piling	1A43	1P42	MSE and gravity wall leveling pad	0.63	750	30/35/40	2 - 4"	3000 psi	2.D.1
	1C62	1P62	Piling, spread footing leveling pad	0.63	750	30/35/40	3 - 6"	3000 psi	2.D.1
R Pavement Rehabilitation	3A32 3B42	3R52	CPR - Full depth concrete repairs, concrete base	0.45	750	30/35/40	2 - 5"	4000 psi	2.D.3
S Bridge Superstructure	3Y16	3S12	Slipform bridge barrier, parapets, end post	0.42	750	30/35/40	½ - 1" #	4000 psi	2.D.2
	3A32 3A42 3Y43 3Y46 3Y46A	3S52	Median barrier, raised median, pilaster, curb, sidewalk, approach panel, formed bridge barrier, parapet, end post, collar	0.45	750	30/35/40	2 - 5"	4000 psi	2.D.2
	1X62 1X46	1X62	Cofferdam seals, rock sockets, drilled shafts	0.45	750	30/35/40	3 - 6"	5000 psi	2.D.1
X Miscellaneous Bridge	3X46	3X62	Drilled shafts above frost line	0.45	750	30/35/40	3 - 6"	5000 psi	2.D.1
Y Bridge Deck	3Y33 3Y33A 3Y36 3Y36A	3Y42-M § 3Y42-S §	Bridge decks, integral abutment diaphragms, pier continuity diaphragms, expansion joint replacement mix	0.45	750	30/35/40	2 - 4"	4000 psi	2.D.2
	3A37 3Y37	3Y47 **	Deck patching mix	0.45	750	30/35/40	2 - 4"	4000 psi	2.D.2

* If the intended use is not included elsewhere in the Specification or Special Provisions, use mix 3G52, unless otherwise directed by the Engineer.

|| The minimum water/cement (w/c) ratio is 0.30.

† Mix 3F57EX requires the use of Coarse Aggregate Designation "7", "2" or "3" for the 4th digit in accordance with Table 2461-3.

‡ Identify specific color used on the certificate of compliance. Colored concrete is only allowed when specified in the plans or the Contract.

Adjust slump in accordance with 2461.3.G.7.a for slipform concrete placement.

§ The "-S" indicates a bridge deck with a structural slab and "-M" indicates a monolithic bridge deck.

** Mix 3Y47 requires the use of Coarse Aggregate Designation "7" or "3" for the 4th digit in accordance with Table 2461-3.

S-3.4 Table 2461-7 of MnDOT 2461.2.F.2.b(3) shall be deleted and replaced with the following:

Table 2461-7 High-Early (HE) Concrete Requirements (Not applicable to Bridge Superstructure or Mass Concrete)								
Mix Number	Concrete Grades Allowed	Minimum Time to Opening	Maximum w/c ratio	Maximum Cementitious Content (lbs/ yd ³) *	Slump Range	Minimum Strength to Opening	Minimum 28-day Compressive Strength, f'c	3137 Spec.
1PHE62	P	-	0.63	750	3 - 6"	-	3000 psi	2.D.1
3HE32	F	48 hrs	0.42	750	1 - 3" †	3000 psi	4500 psi	2.D.1
3HE52	B, F, G	48 hrs	0.42	750	2 - 5"	3000 psi	4500 psi	2.D.1
3YHE52	Y (Repairs Only)	48 hrs	0.42	750	2 - 5"	3000 psi	4000 psi	2.D.2
3RHE52	R (Repairs Only)	48 hrs	0.42	750	2 - 5"	3000 psi	4000 psi	2.D.3
* Supplementary Cementitious Materials allowed. Used only for placing concrete in piles during freezing temperatures, provide 30 percent additional cement to the concrete mix for concrete 10 feet below the ground line or water line in accordance with 2452.3.D.6, "Cast-in-Place Concrete Piles." † Adjust slump in accordance with 2461.3.G.7.a, "Concrete Placed by the Slip-form Method."								

S-3.5 Table 2461-8 of MnDOT 2461.2.F.2.b(3) shall be deleted and replaced with the following:

Table 2461-8 Project Specific Contractor Designed Mixes			
Concrete Grade	Intended Use	Specification	3137 Spec.
A	Concrete Pavement	2301	2.D.3
M, V, W, Z	Precast Concrete	2462	Varies
HPC	High Performance Concrete	Special Provision 2401	2.D.2
MC	Mass Concrete	Special Provision 2401	Varies
CLSM	Cellular Concrete Grout	2519	None
All concrete grades	Delivery time is > 90 minutes	2461.3.G.3.a	Varies

S-3.6 MnDOT 2461.2.F.3 shall be deleted and replaced with the following:

F.3 Submittal Requirements

At least 21 calendar days before initial placement of the concrete, submit the appropriate *General Concrete Mix Design Submittal* form to the Concrete Engineer for approval. Always use the most current forms available from the MnDOT Concrete Engineering Website.

Design the concrete mix to an absolute volume of 27.00 – 27.27 cu. ft.

The Concrete Engineer will:

- (1) Provide specific gravity and absorption data using oven dry (OD) weights for mix design calculations.
- (2) Review the mix design submittal and approve the materials and mix design for compliance with the Specifications.

Table 2461-9 defines the mix design submittal requirements for Level 1 and Level 2 Mixes.

S-3.7 Table 2461-9 of MnDOT 2461.2.F.3 shall be deleted and replaced with the following:

Table 2461-9 Mix Design Submittal Requirements					
	SCM Substitution Limits	Fine Aggregate Limit	Gradation Requirements	Preliminary Test Data Requirements	Submittal Package
Level 1 Mixes *	Fly Ash: 0 – 15% Slag: 0 – 35%	40 – 45% of total aggregate by volume	3126 and 3137	None	General Concrete Mix Design
Level 2 Mixes	Fly Ash: > 15% Ternary: Any	None	Use Either: • 3126 and 3137 • Job Mix Formula (JMF)	2461.2.F.3.a	Use Either: • General Concrete Mix Design • General Concrete Mix Design (JMF)
* High Early concrete in accordance with Table 2461-7 is defined as a Level 1 Mix. Fine aggregate limit does not apply to exposed aggregate concrete mixes.					

S-3.8 The second paragraph of MnDOT 2461.2.F.3.a(1) shall be deleted and replaced with the following:

The Concrete Engineer considers a suitable experience record to have the following characteristics as compared to the proposed mix:

- (A) A required average strength (f'_{cr}) no greater than 1000 psi above the required 28-day compressive strength,
- (B) Same type or grade of cementitious materials,
- (C) Same class of coarse aggregate,
- (D) Same supplementary cementitious proportion,
- (E) Aggregate weights within 10% of the proposed,
- (F) Water/Cement ratio no greater than 0.45,
- (G) Total cementitious weight within 5% of proposed, and
- (H) Batching conditions and testing procedures similar to those expected for the proposed work.

S-3.9 Table 2461-10 of MnDOT 2461.2.F.3.b shall be deleted and replaced with the following:

Table 2461-10 Required Average Strength (f'_{cr}) Equations*	
	Required Average Strength
$f'c \leq 5000$ psi*	$f'_{cr} = f'c + 1.34S$ OR $f'_{cr} = f'c + 2.33S - 500$
$f'c > 5000$ psi	$f'_{cr} = 0.90f'c + 2.33S$
*When $f'c \leq 5000$ psi, f'_{cr} is the larger value computed from the equations.	

S-3.10 Table 2461-11 of MnDOT 2461.2.F.4 shall be deleted and replaced with the following:

Table 2461-11 Mix Design Adjustments Requirements	
	Mix Design Resubmittal Requirements
	Type of Change or Adjustment

Level 1 Mixes	• Cementitious Sources • Admixture Sources • Admixture Dosage Rate	No resubmittal required
	• Aggregate Sources • Aggregate Proportions • Any cementitious proportion ($\leq 15\%$ max fly ash)	Resubmittal of Mix Design
	• Any cementitious proportion ($> 15\%$ max fly ash)	Resubmittal in accordance with 2461.2.F.3.a
Level 2 Mixes	• Cementitious Sources • Admixture Dosage Rate	No resubmittal required
	• Aggregate Source, no change in Aggregate Class • $\leq 5\%$ Total Cementitious • $\leq 10\%$ Aggregate Weights	Resubmittal of Mix Design
	• Aggregate Source and Class of Coarse Aggregate • Supplementary Cementitious Proportion • $> 5\%$ Total Cementitious • $> 10\%$ Aggregate Weights • Admixture Sources	Resubmittal in accordance with 2461.2.F.3.a
* Only one (1) increase in total cementitious allowed per mix design, next adjustment requires resubmittal in accordance with 2461.2.F.3.a, “Preliminary Test Data Requirements for Level 2 Mixes”		

S-3.11 MnDOT 2461.3.D shall be deleted and replaced with the following:

D Batching Requirements

The Concrete Engineer will allow only Large Capacity Scale companies authorized by the Minnesota Department of Commerce, Weights and Measures Division to calibrate weighting equipment and meters for MnDOT projects. A list of authorized companies is available from the MnDOT Concrete Engineering Unit website.

Calibration of weighing equipment is required within three months prior to plant certification each calendar year. Calibrate weighing equipment and perform spot checks in accordance with the Concrete Manual.

S-3.12 The second paragraph of MnDOT 2461.3.D.1.c shall be deleted and replaced with the following:

Calibration of the water meter is required within three months prior to plant certification each calendar year. Calibrate the water meter and perform spot checks in accordance with the Concrete Manual.

S-3.13 MnDOT 2461.3.F through MnDOT 2461.3.F.5.f shall be deleted and replaced with the following:

F Certified Ready-Mix Concrete

Provide concrete from a certified ready-mix plant listed on the MnDOT Concrete Engineering Unit website. Ensure the Producer performs quality control of concrete production and complies with the MnDOT Certified Ready-Mix Plant Program.

Provide batches for a delivered load of concrete in sizes of at least 1 cu. yd.

The Engineer may reject ready-mix concrete delivered to the work site that does not meet the specified requirements for delivery time, consistency, quality, air content, or other properties, as unauthorized or unacceptable work in accordance with 1512, “Unacceptable and Unauthorized Work.”

F.1 Certified Ready-Mix Plant Program

The Producer will perform Quality Control (QC) under the certification program for ready-mix concrete plants in accordance with 2461.3.F.4, "Contractor Quality Control." The Engineer will perform Quality Assurance (QA) as part of the acceptance process in accordance with 2461.3.F.5, "Agency Quality Assurance."

F.1.a Plant Certification

Prior to the production of Department concrete each construction season, a MnDOT Certified Concrete Plant Technician, representing the Department, shall perform a thorough on-site inspection of the concrete plant with a MnDOT Certified Concrete Plant Technician, representing the Producer.

In order to obtain certification, complete the following:

- (1) The Producer will complete MnDOT Form 2163, *Concrete Plant Contact Report*, prior to the on-site inspection with the Department Representative.
 - (1.1) A MnDOT Certified Concrete Plant Technician, representing the Producer, signs the *Concrete Plant Contact Report* certifying compliance with the Certified Ready Mix requirements and continual maintenance of the plant to assure that the plant can produce concrete meeting MnDOT Specifications.
 - (1.2) A MnDOT Certified Concrete Plant Technician, representing the Department, signs the *Concrete Plant Contact Report* signifying that the plant complies with all requirements prior to concrete production.
- (2) Identify all persons responsible for testing and overseeing plant operations on MnDOT Form 2163, *Concrete Plant Contact Report*. Provide their email, cell phone number, and MnDOT Technical Certification number.
- (3) Include a site map showing stockpile locations identified with the MnDOT pit number.
- (4) Provide cementitious and admixture samples.
- (5) Provide a computerized batching system capable of meeting the requirements of 2461.3.F.2, "Certificate of Compliance."
- (6) Provide continuous access on-site to the Concrete Manual available from MnDOT's website.
- (7) Supply a working email address, including an active internet connection, at the certified ready-mix plant.
- (8) Provide calibrated electronic scales for weighing all materials.
- (9) Provide facilities in accordance with 1604, "Plant Inspection – Commercial Facility," for the use of the plant technician in performing tests.

The Department Representative will submit the completed Contact Report and current Certificate of Compliance to the MnDOT Concrete Engineer for final determination of certification.

F.1.b Maintaining Plant Certification

The Producer will maintain plant certification by:

- (1) Displaying the current Contact Report and site map in plain sight at all times.
- (2) Updating the Contact Report with any material or equipment changes and submitting to the Department.
- (3) Making Producer Plant QC Workbook and QC charts available electronically at all times.
- (4) Performing the responsibilities identified in 2461.3.F.4, "Contractor Quality Control."
- (5) Supplying the following information at the request of the Engineer:
 - (5.1) Approved mix design sheets,
 - (5.2) Agency cementitious and admixture test results,
 - (5.3) Agency verification gradation test results,
 - (5.4) Aggregate quality test results.
- (6) Keeping plant reports, charts, and supporting documentation on file at the plant site for 5 calendar years.

F.1.c Certified Ready-Mix Plant Decertification

The Concrete Engineer, with coordination from the Engineer, may decertify the plant and halt production of concrete under any of the following conditions:

- (1) Unauthorized procedural, material, or equipment changes made after the completion of the Concrete Plant Contact Report,
- (2) Failure to meet the required testing rates,
- (3) Failure to complete required documents,
- (4) Failure to provide competent MnDOT Certified Plant Technicians,
- (5) Disregard of any of the requirements of 2461.3.F, "Certified Ready-Mix Concrete," or
- (6) Falsification of test records or certificates of compliance.

F.2 Certificate of Compliance

Provide a computerized Certificate of Compliance with each truckload of ready-mixed concrete at the time of delivery. The Department defines computerized to mean a document that records mix design quantities from load cells and meters.

If the computer that generates the Certificate of Compliance malfunctions, the Engineer may allow the Contractor to finish any pours in progress if the Producer issues a handwritten MnDOT Form 0042, *Certificate of Compliance* with each load. The Engineer will not allow the Producer to begin new pours without a working computerized Certificate of Compliance.

Provide a computerized Certificate of Compliance that includes all of the following information:

- (1) Name of the ready-mix concrete plant,
- (2) Name of the Contractor,
- (3) Date,
- (4) State Project Number (SP) or (SAP),
- (5) Bridge Number (if applicable),
- (6) Time concrete was batched,
- (7) Truck number,
- (8) Quantity of concrete in this load,
- (9) Running total of each type of concrete, each day for each project,
- (10) Type of concrete (MnDOT Mix Designation Number),
- (11) Cementitious materials using MnDOT Standard Abbreviations,
- (12) Admixtures using MnDOT Standard Abbreviations,
- (13) Aggregate sources using 5 digit State Pit Numbers,
- (14) Admixture quantity in fluid ounces per 100 lb of cementitious materials or ounces per cubic yard,
- (15) Batch weights in columns in accordance with Table 2461-12:
 - (15.1) Print in order a through k.
 - (15.2) Use formula to calculate weights.
 - (15.3) Head columns with Standard Labels.

Table 2461-12 Standard Certificate of Compliance Labels			
	Formula Letter	Formula	Standard Label
a	Ingredients (aggregate, cementitious, water, admixture type)	—	Ingredient
b	Product Source (MnDOT Standard Abbreviation)	—	Source
c	Total Moisture Factor (in decimals to 3 places)	—	MCFac
d	Absorption Factor (in decimals to 3 places)	—	AbsFac
e	MnDOT mix design oven dry (OD) weights, <i>lb/cu. yd</i>	—	OD
f	Absorbed moisture in the aggregates, <i>lb/cu. yd</i>	$(e \times d)$	Abs
g	Saturated surface dry (SSD) weights for aggregates, <i>lb/cu. yd</i>	$(e + f)$	SSD
h	Free moisture, <i>lb/cu. yd</i>	$(c - d) \times e$	Free Mst
i	Target weights for one cubic yard of concrete, <i>lb/cu. yd</i>	$(g + h)$	CY Targ
j	Target batch weights, <i>lb</i>	$(cu. yd \times i)$ $[cu. m \times i]$	Target
k	Actual batch weights, <i>lb</i>	—	Actual
NOTE: Actual cubic yards batched may vary due to differences in air content, weight tolerances, specific gravities of aggregates, and other variables.			

- (16) Total Water (Batch Water + Free Moisture) in pounds,
- (17) Water available to add [(Mix Design Water $\times$ Batch Size) – Total water] in gallons,
- (18) Space to note the water adjustment information, including:
 - (18.1) Water in gallons added to truck at plant (filled in by Producer, enter zero if no water is added),
 - (18.2) Water in gallons added to truck at the jobsite (filled in by Producer or Engineer, enter zero if no water is added), and
 - (18.3) Total actual water in pounds (Total Water from Certificate of Compliance plus any additions).
- (19) The following information printed with enough room beside each item to allow the Engineer to record the test results:
 - (19.1) Air content,
 - (19.2) Air temperature,
 - (19.3) Concrete temperature,
 - (19.4) Slump,
 - (19.5) Cylinder number,
 - (19.6) Location or part of structure,
 - (19.7) Time discharge, and
 - (19.8) Signature of Inspector.
- (20) Location for the Producer signature,
- (21) For colored concrete, final color.

F.3 Definitions

The Department defines ready-mix concrete as one of the following:

- (1) Central-mixed concrete proportioned and mixed in a stationary plant and hauled to the point of placement in revolving drum agitator trucks or a truck mixer, or
- (2) Truck-mixed concrete proportioned in a stationary plant and fully mixed in truck mixers.

Table 2461-13 defines commonly used certified ready-mix terms.

Table 2461-13 Certified Ready-Mix Terminology	
Term	Definition
Mix design water	The maximum allowable water content for 1 cu. yd of concrete.
Total moisture factor	Factor used to determine total amount of water carried by a given wet aggregate.
Absorption factor	Factor used to determine the water contained within the pores of the aggregate and is held within the particles by capillary force.
Free moisture	The water that is carried on the surface of the aggregate that becomes part of the total water.
Batch water	Water actually batched into the truck by the batcher. Batch water includes potable water and clarified water.
Total water	Batch water added to free moisture. Total water may also include the water used in diluting admixture solutions.
Temper water	Water added in mixer to adjust slump.
Total actual water	The water in the concrete mixture at the time of placement from any source other than the amount absorbed by the aggregate. It includes all batch water placed in the mixer, free moisture on the aggregate and any water added to the ready mix truck prior to placement.
Ready-Mix Producer or "Producer"	Party that is producing the concrete for the Contract. It is understood that the Ready-Mix Producer is the agent of the Contractor.
Water/Cement (w/c) Ratio	W/C ratio is defined as the ratio of the total water weight to the total cementitious weight, which includes cement and supplementary cementitious materials.
Real time	The actual time during which something takes place.

F.4 Contractor Quality Control (QC)

The Producer's daily responsibilities include the following:

- (1) Provide qualified personnel.
- (2) Maintain laboratory equipment within allowable tolerances.
- (3) Randomly spot check concrete batching to verify batch weights and tolerances.
- (4) Check the bins and piles for segregation, contamination, or interblending of the aggregates.
- (5) Check that mix trucks are clean, blades are not worn, and revolution counters are working properly.

F.4.a Personnel

The Producer will provide the following personnel:

- (1) QC Plant Technician(s) to perform all testing and quality control requirements of 2461. The QC Plant Technician shall hold a current MnDOT Concrete Plant Certification.
- (2) Quality Control Supervisor responsible for oversight of all QC testing and daily plant operations. The Quality Control Supervisor shall hold a current MnDOT Concrete Plant Certification and is required to remain on-site during concrete production or have cellular phone availability.
- (3) Quality Control Manager responsible for oversight of the Quality Control Supervisor and the certified ready-mix plant program.

F.4.b Sampling and Testing

Take aggregate, cementitious, and admixtures samples in accordance with ASTM D 3665, Section 5, at a rate defined in the Schedule of Materials Control. Perform sampling and testing in accordance with the Concrete Manual. The Engineer may oversee the QC sampling and testing process.

Perform gradation and moisture testing at the certified ready-mix plant site. Use mechanical shakers for sieve analysis.

Provide equipment and perform calibrations meeting the requirements of the following:

- (1) AASHTO T 27, "Sieve Analysis of Fine and Coarse Aggregates,"
- (2) AASHTO T 255, "Total Moisture Content of Aggregate by Drying,"
- (3) AASHTO M 92, "Wire-cloth Sieves for Testing Purpose," and
- (4) AASHTO M 231, "Weighing Devices Used in the Testing of Materials."

F.4.c Aggregate Gradations

Complete the *Concrete Aggregate Worksheet* for each aggregate size and source:

- (1.1) QC Gradations: If a QC gradation fails, retest immediately documenting both results. If an additional QC test is required for that week, the Engineer will not allow a retest gradation as a substitute for a QC gradation.
- (1.2) Verification Companion Gradations: The Engineer will not allow a verification companion gradation as a substitute for a QC gradation.

Identify QC companion samples with the following information:

- (2.1) Date,
- (2.2) Test number,
- (2.3) Time,
- (2.4) Type of material,
- (2.5) Plant, and
- (2.6) Sampling location.

F.4.d Moisture Content

Determine the moisture content using the oven-dry method in the Concrete Manual. Complete the *Batching Report* for each aggregate size and source. Observe the batch person enter moisture contents into the batching system. Verify the moisture contents were entered correctly on the Certificate of Compliance.

F.4.e Concrete Ready-Mix Plant QC Workbook

Complete the *Concrete Ready-Mix Plant QC Workbook* which includes all of the following documents:

- (1) Diary
- (2) Batching Report
- (3) Concrete Aggregate Worksheet
- (4) Weekly Concrete Aggregate Report
- (5) JMF Concrete Aggregate Worksheet
- (6) JMF Weekly Concrete Aggregate Report

The Producer will maintain the *Concrete Ready-Mix Plant QC Workbook* in real time using their full name for the diary and each test performed.

Submit to the Engineer and the Concrete Engineering Unit by the Tuesday immediately following the previous week's production.

F.4.f Aggregate Gradation Control Charts and Sample Log

- (1) Complete the *Aggregate Gradation Control Charts* in real time for each aggregate size and aggregate source:
 - (1.1) Record Producer QC gradation and Verification Companion gradation results. These results are included in the moving average calculation.
 - (1.2) Record Verification Gradation results. These results are not included in the moving average calculation.
- (2) Complete *Sample Log* in real time for all samples taken:
 - (2.1) Record all aggregate samples taken by the Agency.

- (2.2) Record cementitious and admixture samples taken by the Producer and picked up by the Agency.

F.4.g Signing the Certificate of Compliance

The Producer's MnDOT Certified Concrete Plant Technician will:

- (1) Review the first Certificate of Compliance for each mix type, each day, for accuracy; and
- (2) Legibly hand sign the Certificate of Compliance at a location designated for Producer signature signifying agreement to the terms of this program and to certify that the materials comply with the requirements of the Contract; and
- (3) Print their name and write their MnDOT Technical Certification Number next to their signature.

F.5 Agency Quality Assurance (QA)

The Engineer's responsibilities each time the plant is visited include the following:

- (1) Confirm the *Concrete Ready-Mix Plant QC Workbook* and *Aggregate Gradation Control Charts* are accurate and up-to-date.
- (2) Check Certificate of Compliance for completeness and accuracy.
- (3) Spot check concrete batching to verify batch weights and tolerances.
- (4) Check the bins and stockpiles for segregation, contamination, and interblending of the aggregates.
- (5) Obtain aggregate samples per Schedule of Materials Control.
- (6) Observe Producer's Certified Technician obtain aggregate samples and run gradation and moisture tests when possible.
- (7) Verify cementitious and admixtures are certified and approved. Collect cementitious and admixtures samples per the Schedule of Material Control.

Provide the following Agency test results to the Producer in a timely manner:

- (8.1) Cementitious Materials
- (8.2) Admixtures
- (8.3) Gradations
- (8.4) Coarse Aggregate Quality
- (9) If any equipment malfunctions, testing procedures or test results are questionable, or unusual activity is occurring during the plant visit perform the following:
 - (9.1) Continue monitoring at the plant and document observations in the diary.
 - (9.2) Investigate to determine the origin of the concern and document the resolution.
 - (9.3) Contact Independent Assurance Inspector, Project Engineer or Concrete Engineering Unit when necessary.

F.5.a Personnel

The Department will provide MnDOT Certified Concrete Plant Technicians to perform all of the duties of 2461.3.F.5, "Agency Quality Assurance."

F.5.b Sampling and Testing

Take all samples randomly in accordance with ASTM D 3665, Section 5, at a rate defined in the Schedule of Materials Control. Perform all sampling and testing in accordance with the Concrete Manual. Use mechanical shakers for sieve analysis.

F.5.c Aggregate Gradations

The Engineer will:

- (1) Complete the *Weekly Ready-Mix Plant Report* for each aggregate size and source.
- (2) Compare the Agency results with the Producer's companion gradation result for compliance with lab/field tolerance in accordance with 2461.3.F.6.b, *Lab Field Tolerance*.

F.5.d Batch Weight Verification

Each time the Engineer visits the plant, they will observe the actual water batched in a single load of concrete in accordance with the following:

- (1) Watching the ready-mix truck reverse the drum after washing,
- (2) Verifying use of the current moisture test,
- (3) Verifying that any additional water added to adjust the slump is recorded, and
- (4) Validating water weights on the load batched and comparing the total water with the design water.

The Engineer will document the actual water batched on the *Weekly Ready-Mix Plant Report*.

F.5.e Concrete Ready-Mix Plant QA Workbook

The Engineer will complete the *Concrete Ready-Mix Plant QA Workbook* in real time which includes all of the following documents:

- (1) Diary
- (2) Weekly Certified Ready-Mix Plant Report
- (3) Concrete Aggregate Worksheet if gradation testing performed in the field
- (4) JMF Concrete Aggregate Worksheet if gradation testing performed in the field

Submit to the Engineer and the Concrete Engineering Unit by the Tuesday immediately following the previous week's production.

F.5.f Non-compliance with Certified Ready-Mix Plant Program

If the Engineer observes the Producer not complying with the requirements of the Certified Ready-Mix Plant Program, the Engineer will perform the following:

- (1) Verbally notify and promptly email the Producer and the Concrete Engineer the list of observed deficiencies and provide a deadline to correct the non-compliance.
- (2) If non-compliance is not corrected by the deadline, notify the Contractor and Producer that concrete production is unauthorized in accordance with 1512, "Unacceptable and Unauthorized Work."

The Concrete Engineer will determine if the severity of the non-compliance results in decertification of the plant in accordance with 2461.3.F.1.c, "Certified Ready-Mix Plant Decertification."

S-3.14 MnDOT 2461.3.G.3.a(1) shall be deleted and replaced with the following:

- (1) Provide a contractor mix design in accordance with 2461.2.F.2.b, "Contractor Designed Concrete Mixes," for each combination of materials;

S-3.15 MnDOT 2461.3.G.5(3.1) and 2461.3.G.5(3.2) shall be deleted and replaced with the following:

- (3.1) A minimum of at least 16 hours after casting for all grades of concrete except mass concrete (Grade MC). Transport mass concrete a minimum of at least 24 hours after casting.
- (3.2) A minimum of at least 12 hours after casting high early standard strength cylinders.

S-3.16 MnDOT 2461.3.G.5.a(2) shall be deleted and replaced with the following:

- (2) Maintain the standard strength cylinders or beams in an ambient temperature range from 60 °F to 80 °F during the initial and intermediate curing periods.

S-3.17 The first paragraph of MnDOT 2461.3.G.5.b shall be deleted and replaced with the following:

G.5.b Standard Strength Cylinders

All standard strength cylinders have a minimum 28-day strength requirement unless modified elsewhere in the Contract.

The Engineer will perform the following for standard strength cylinders:

- (1.1) Cast cylinders (sets of 3) for testing in accordance with the Schedule of Materials Control or as modified by the Contract.
- (1.2) Mark cylinders for identification of the represented unit or section of concrete in accordance with the following: (1.1, 1.2, 1.3/ 2.1, 2.2, 2.3/ 3.1, 3.2, etc.). In order to differentiate between portions of a project, prefixes and suffixes are allowed.
- (1.3) Cure the cylinders meeting the requirements of the 2461.3.G.5.a, "Moist Curing Environments."
- (1.4) Complete the MnDOT Concrete Cylinder Identification Card including the results for air content, slump (if required), concrete, and air temperature testing from the same load.

S-3.18 MnDOT 2461.3.G.5.e shall be deleted and replaced with the following:

G.5.e Concrete Compressive Strength

The Concrete Engineer defines a **strength test** as the average strength of three (3) cylinders fabricated from the same sample of concrete and cured in accordance with the 2461.3.5.a and 2461.3.G.5.d.

The maximum allowable range between the individual cylinders in a strength test is 350 psi. The Concrete Engineer will remove all individual cylinder strengths that are more than 350 psi below the highest individual cylinder strength and recalculate the strength.

The Engineer will review standard strength test results for acceptance in accordance with Table 2461-17 and 2461.3.G.5.f.

Table 2461-17 Acceptance Criteria for Standard Strength Cylinders		
	Strength Test	Moving average of 3 consecutive strength tests *
$f'_c \leq 5000$ psi	$> (f'_c - 500 \text{ psi})$	$\geq f'_c$
$f'_c > 5000$ psi	$> 0.90 * f'_c$	$\geq f'_c$
* If a project does not establish a moving average of 3 consecutive strength tests, use the average of 2 strength tests to determine acceptance. If there is only a single strength test, contact the Concrete Engineer for recommendation.		

S-3.19 MnDOT 2461.3.G.5.f shall be deleted and replaced with the following:

G.5.f Non-Conforming Material

If the Contractor places concrete not meeting the strength requirements of 2461.3.G.5.e, "Concrete Compressive Strength" into the work, the Engineer may not accept nonconforming concrete at the contract unit price. The Engineer will evaluate non-conforming strength results in accordance with the following:

G.5.f(1) Strength Test ≤ 500 psi Below f'_c

If any strength test result shows a strength ≤ 500 psi below f'_c and is not deficient due to erroneous/invalid strength tests as defined in 2461.3.G.5.f(4), "Moving Average Below f'_c ", no additional investigation will occur and the Engineer will include the low strength test result in the moving average.

G.5.f(2) Strength Test > 500 psi Below f'_c

If any strength test result shows a strength > 500 psi below f'_c and is not deficient due to erroneous/invalid strength tests as defined in 2461.3.G.5.f(4), "Moving Average Below f'_c ", the Engineer, in conjunction with the Concrete Engineer, will investigate to determine if the concrete has attained the critical load-carrying capacity.

The investigation may consist of, but is not limited to reviewing the following:

- (A) Sampling and testing plastic concrete
- (B) Handling of cylinders
- (C) Cylinder curing procedures

- (D) Compressive strength testing procedures
- (E) Certificate of Compliances
- (F) Evaluation using Rebound Hammer (ASTM C803), Penetration Resistance (ASTM C805), or other method approved by the Concrete Engineer
- (G) Review of the design calculations for the concrete in question

If it is determined that the concrete represented by the standard strength test has attained the critical load carrying capacity, the Engineer will include the strength test in the moving average calculation.

If it is determined that the concrete has not attained the critical load carrying capacity, the Engineer will direct the Contractor to remove and replace concrete in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work." The Contractor may dispute the remove and replace order within 7 days of written notification by the Engineer. If the Contractor disputes the order, follow the dispute resolution coring procedure in accordance with 2461.3.G.5.f(3), "Dispute Resolution Coring for a Strength Test Failure."

G.5.f(3) Dispute Resolution Coring for a Strength Test Failure

The Engineer and Contractor will mutually agree on an Independent Third Party to core and test the concrete in accordance with ASTM C42 and the following:

- (A) The Engineer will identify a minimum of three (3) locations for the Independent Third Party to core.
- (B) The Independent Third Party will take one (1) core at each location.
- (C) The Independent Third Party will complete all coring within 14 days of notification of the low strength concrete.
- (D) The Contractor is responsible for ensuring the core holes are repaired.

The Engineer, in conjunction with the Concrete Engineer, will review the core test results and evaluate in accordance with Table 2461-18, providing all other concrete tests meet requirements.

Table 2461-18 Evaluation of Core Test Results			
Core (average of 3 cores) Test Results:	Engineer considers concrete:	Cost of Coring and Testing:	Resolution:
$\geq 85\%$ of f'_c and No individual core is < 75% of f'_c	Acceptable to remain in place	Agency	No monetary reduction for single strength test failure.
< 85% of f'_c	Unacceptable	Contractor	Remove and replace concrete in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work," as directed by the Engineer, in conjunction with the Concrete Engineer.

G.5.f(4) Moving Average Below f'_c

If the moving average of three (3) consecutive strength tests is less than the required f'_c , the Concrete Engineer will review the strength test results and determine if a new mix design is required.

The Concrete Engineer, in conjunction with the Engineer, will remove any strength test results from the moving average if the following occurs:

- (A.1) After investigation, the deficient concrete strength is found to be caused by improper handling, curing, or testing of the cylinder;
- (A.2) Cylinders kept in the field longer than 7 days that negatively impact the moving average calculation;

- (A.3) The suspect concrete was removed and replaced;
(A.4) Dispute resolution coring identified the concrete acceptable to remain in place.

For the quantity of non-conforming concrete not meeting the moving average of three (3) consecutive strength tests, the Engineer will make determinations regarding the disposition, payment, or removal of the concrete in accordance with Tables 2461-19.

Table 2461-19 All Concrete Grades	
Moving average of 3 consecutive strength tests	Monetary Reduction for Moving Average Failure *
> 98.0% of f'_c	No deductions for the materials placed as approved by the Engineer.
93.0% to 98.0% of f'_c	\$20.00 per cubic yard or 10% of the Contractor-provided invoice for quantity represented by test that brought moving average into non-conformance
87.5% to < 93.0% of f'_c	\$50.00 per cubic yard or 25% of the Contractor-provided invoice for quantity represented by test that brought moving average into non-conformance
< 87.5% of f'_c	Remove and replace concrete in accordance with 1503, "Conformity with Contract Documents," and 1512, "Unacceptable and Unauthorized Work," as directed by the Engineer. If the Engineer, in conjunction with the Concrete Engineer, determines the concrete can remain in place, the Engineer will adjust the concrete at a reduction of \$100.00 per cubic yard or 50% of the Contractor-provided invoice for quantity represented by test that brought moving average into non-conformance.

S-4 **(2462) PRECAST CONCRETE**
REVISED 12/08/17
SP2018-157

MnDOT 2462 is hereby modified as follows:

- S-4.1 Table 2462-4 of MnDOT 2462.2.F.2 shall be deleted and replaced with the following:

Table 2462-4 Precast Concrete Mix Design Requirements								
Concrete Grade	Mix Number *	Intended Use	Maximum w/c ratio	Cementitious Content (lbs/cy)	Maximum %SCM (Fly Ash/ Slag/ Ternary)	Slump Range ‡	Minimum Compressive Strength, f'c (28-day) #	3137 Spec.
M	3M82	Precast Concrete Barrier	0.45	530 – 750	30/35/40	1 – 8"	4500 psi	2.D.1
V	3V82	Wetcast retaining wall blocks, noisewall panels, equipment pad	0.45	605 – 850	30/35/40	1 – 8"	4000 psi	2.D.1
W	1W82	Bridge Girders	0.42	660 – 850	30/35/40	1 – 8"	Design Strength Per Plan	2.D.1
	3W82	Noisewall posts, box culverts, bridge girders†	0.42	660 - 850	30/35/40	1 – 8"	Design Strength Per Plan	2.D.1
Z	3Z82	Thin Panel Retaining Walls	0.45	605 – 850	30/35/40	1 – 8"	4000 psi	2.D.2
* The Precaster may choose to use the Coarse Aggregate Designation "1" for the 4 th digit in accordance with Table 2462-3, if allowed by the structure. If the intended use is not included elsewhere in the Specification or Special Provisions, design concrete mix 3W82. † Review the Plans to determine if the bridge girders require air entrainment. ‡ Flowable slumps exceeding the designated slump range require approval of the MnDOT State Materials Engineer. # Requires strength cylinders in accordance with 2462.3.G.4 for determining shipping strength.								

S-4.2 The first sentence of MnDOT 2462.2.F.1.b shall be deleted and replaced with the following:

The Department will designation concrete grade in accordance with Table 2462-4 using a letter to represent the following:

S-4.3 MnDOT 2462.3.G.4 shall be deleted and replaced with the following:

G.4 Test Methods and Specimens

Perform sampling and testing in accordance with the Concrete Manual and test according to the requirements of the Schedule of Materials Control.

Anyone fabricating concrete cylinders is required to hold either a current ACI Field 1 Technician Certification or a MnDOT Field 1 Technician Certification.

Anyone performing concrete strength testing of cylinders is required to hold one of the following current certifications:

- (1.1) ACI Strength Testing Technician Certification,
- (1.2) MnDOT Strength Testing Technician Certification, or
- (1.3) WisDOT Strength Testing Technician Certification.

Furnish molds based on the maximum size aggregate for the test specimens in accordance with the following:

- (2.1) 4 in × 8 in cylinder molds,
- (2.2) 6 in × 12 in cylinder molds for maximum aggregate sizes greater than 1¼ in.

G.4.a Strength Cylinders

The Precaster will cast all strength cylinders to determine the following:

- (3.1) Handling or “Stripping” Strength
- (3.2) Shipping Strength
- (3.3) Verification

Cast all cylinders used for determining strength at each stage for all types of precast operations. Cure all cylinders in the same location and under the same conditions as the concrete structure or unit involved meeting the requirements of ASTM C31.

S-5 (2472) METAL REINFORCEMENT

REVISED 08/09/18

SP2018-158.1

The provisions of MnDOT 2472 are modified with the following:

S-5.1 Delete and replace MnDOT 2472.4A with the following:

A Reinforcement Bars

The Engineer will measure Reinforcement Bars, including reinforcement in bar mats, by the weight incorporated into the structure in accordance with 2472-3. The Engineer will only include quantities for splices shown in the plans.

Reinforcement bars may be marked in either U.S. Customary or metric sizes. The conversion shall be made per the following table:

Table 2472-3 Reinforcement Bars Theoretical Weights Nominal Dimensions				
U.S. Customary Bar Size	Metric Bar Size*	Nominal Dimensions		
		Diameter, in [mm]	Area in ² [mm ²]	Weight, lb/ft [kg/m]
3	10	0.375 [9.5]	0.11 [71]	0.376 [0.560]
4	13	0.500 [12.7]	0.20 [129]	0.668 [0.994]
5	16	0.625 [15.9]	0.31 [199]	1.043 [1.552]
6	19	0.750 [19.1]	0.44 [284]	1.502 [2.235]
7	22	0.875 [22.2]	0.60 [387]	2.044 [3.042]
8	25	1.000 [25.4]	0.79 [510]	2.670 [3.973]
9	29	1.128 [28.7]	1.00 [645]	3.400 [5.060]
10	32	1.270 [32.3]	1.27 [819]	4.303 [6.404]
11	36	1.410 [35.8]	1.56 [1006]	5.313 [7.907]
14	43	1.693 [43.0]	2.25 [1452]	7.650 [11.380]
18	57	2.257 [57.3]	4.00 [2581]	13.600 [20.240]
* Bar designation numbers approximate the nominal diameter of the bar in millimeters				

S-6 (3137) COARSE AGGREGATE FOR PORTLAND CEMENT CONCRETE
NEW WRITE-UP 01/04/19
SP2018-252.1

MnDOT 3137 is modified as follows:

S-6.1 MnDOT 3137.2.D shall be deleted and replaced with the following:

D Quality

Provide coarse aggregate in accordance with 3137.2.D.1, 3137.2.D.2 or 3137.2.D.3 and the following:

For fractions greater than or equal to 1 in, base quality requirements on the individual result.

For fractions that have 100 percent passing the 1 in sieve:

- (1) When using a single aggregate, base quality requirements on the individual result.
- (2) When proportioning aggregates, base quality requirements on the composite result. Prior to proportioning, each individual fraction must meet the requirements of 3137.2.D.1.
 - (2.1) If proportioning for 3137.2.D.2, each individual fraction must also meet 3137.2.D.2(g) and 3137.2.D.2(i).
 - (2.2) If proportioning for 3137.2.D.3, each individual fraction must also meet 3137.2.D.3(a) and 3137.2.D.3(b) modified to a maximum percent carbonate by weight of 35.0%.

The Concrete Engineer may reject the proposed aggregate proportions if the composite result is of borderline quality in accordance with 1503, Conformity with Contract Documents.

Refer to Tables 2461-5, 2461-6, 2461-7 and 2462-6 to determine the coarse aggregate quality specification for the intended use.

S-6.2 Table 3137-4 shall be deleted and replaced with the following:

Table 3137-4 Coarse Aggregate Designation for Concrete, <i>percent by weight passing square opening sieves</i>					
	Coarse Aggregate Designation				
	2	3	4	7	8
Sieve Sizes	ASTM #67*	ASTM #7*	ASTM #89	CA-70	CA-80
2 in	-	-	-	-	-
1½ in	-	-	-	-	-
1 in	100	-	-	-	-
¾ in	90 – 100	100	-	-	-
5/8 in	-	-	-	100	-
½ in	-	90 – 100	100	85 – 100	-
⅜ in	20 – 55	40 – 70	90 – 100	50 – 100	100
No.4	0 – 10	0 – 15	20 - 55	0 – 25	55 – 95
No.8	-	-	5 – 30	-	-
No.16	-	-	0 – 10	-	-
No.50	-	-	0 - 5	-	0-5
*ASTM #67 and ASTM #7 Gradations are MnDOT Modified.					



City of Duluth, Minnesota

Public Works & Utilities Department - Engineering Division

Standard Construction Specifications - 2019 Edition

APPENDIX F

Concrete Pavement Rehabilitation (CPR)

Standard Details



Memo

TO: Design Engineers
Maintenance Engineers
Materials Engineers
Resident Engineers
State Aid Engineers
Concrete Paving Association of Minnesota

FROM: Maria A. Masten, Concrete Engineer

DATE: April 22, 2016 **(CPR Details Revised & Dated April 22, 2016)**

SUBJECT: Concrete Pavement Rehabilitation (CPR) Standard Detail and
Special Provision Revisions

REVISIONS OF NOTE:

- 1. All CPR repair details that require reinforcing steel contain revisions to the rebar sizing from metric [mm] back to standard 1/8th inch bar sizing.**

For example, a metric size No.13 bar [13mm] is now a No.4 bar (1/2 inch). CPR details with rebar sizing (metric to standard) revisions include Type BE, Type CD-HV, Type CX, Type CD-LV, Type C1-LV, Type C2-LV, and Type CA-LV. In addition, the “How to Repair Details” also contains metric to standard rebars sizing revisions. These details include, Catch Basin Repair, Curb and Gutter Repair, and Sidewalk / Median Walk Repair.

- 2. Changed the basis of payment on the Type A1 repair detail to “Incidental.”**

Within the limits of Types B (partial depth repairs) and Type C (full depth repairs), the Contractor is required to reestablish and seal all cracks and joints, in accordance with the Type A1 repair detail. For reference, always include the Type A1 repair detail with the basis of payment stated as “Incidental” in the plan set. Unless the project is sealing the in place joints outside Type B&C repairs limits. If so, include the Type A1 repair detail with the basis of payment stated as “Lineal Foot.”

In other words, the project would measure for payment, cracks and joints outside the limits of the Type B & C repairs that receive either a Type A1 repair (saw and seal) or Type A2 repair (clean and seal). Performing Type A1 repair on cracks and joint



within the limits of Type B & C repairs would remain incidental.
Contact the Concrete Engineering Unit for further clarification as to the intended use of Type A1 (Incidental vs. Lineal Foot) and the Type A2 (Lineal Foot) repairs.

3. **Type CD-HV repair detail increased the drill and grout dowel bar diameters from 1-inch dowel bars and increased the diameter to 1.25-inch dowel bars.**
4. **Type CD-HV repair detail now has a note clarifying the number of drill and grout dowel bars required. The note states “Add an additional dowel bar per side for each 1 foot increase in lane width/pay quantity.”**
5. **Both Type CD-HV and CD-LV repair detail and 2302 special provisions requires the drill bit diameter be minimum of 1/8th inch greater in diameter than the diameter of the specified dowel bar.**

Most (if not all) manufactures of non-shrink grout or epoxy adhesive used to anchor dowel bars/reinforcing steel to the in place concrete pavement, require a 1/8th inch to 1/4th inch oversized drilled hole diameter.

Displace the air in the drill hole with adhesive; begin the adhesive application at the back of the hole with a nozzle or hose with enough length to reach the back of the drill hole. Then with a continuous flow of adhesive, slowly pull the injection nozzle/hose outward. Displace the air with adhesive by filling the drill hole ¾ full of an approved non-shrink grout adhesive or epoxy adhesive, prior to installing the dowel bar or reinforcing steel.

The 1/8th to 1/4th inch drill hole oversizing allows the non-shrink grout adhesive or epoxy adhesive injected in the drill hole to freely flow out and around the dowel bar/reinforcing steel, displacing any air voids with adhesive.

Another effect of not drilling sufficient size holes is, the Contractors dowel bar installer begins to “dip and stick” the dowels bars. This is likely due to the inadequate space between the dowel bar and the drill hole walls, making it very hard if not impossible to force the grout or epoxy adhesive from the back of the hole out and around the dowel bar when the bar is installed into the drill hole.

6. **Both the Type CD-HV and Type CD-LV repair details have added a note clarifying the required length of the transverse epoxy coated No. 4 rebar. The note states “No.4 epoxy coated rebar length is equal to the width of the repair, minus 2 feet.”**



7. **One-inch dowel bars used in the Type CX repair and supplied in dowel bar assemblies (Standard Plate 1103) now have a CPR pay item, 2302 Dowel Bars (each). If a project has both concrete paving (2301) and CPR (2302) work, the designer should separately tabulate the paving dowel bars (2301) and the CPR dowel bars (2302) used in Type CX repairs.**
8. **The CD-HV drill & grout dowels increased 1.25” but the dowels supplied in dowel bar assemblies (Standard Plate 1103) will remain 1.0” dowel bars.**
9. **For continuity purposes, all CPR repair details are dated April 22, 2016.**

CONTRACTOR MIX DESIGN REQUIREMENTS:

Starting in the fall of 2015, projects administered under the 2016 edition of MnDOT’s Standard Specification for Construction requires the Contractor to design most concrete mixtures, in accordance with specification 2461. With this new requirement, all CPR concrete batched from a ready mix plant will have revised concrete grade designations. In other words, all Type C repairs that required concrete grades 3A32/3A32HE will now have concrete grades 3R52/3RHE52. In addition, the “How to Repair Details” requires a Contractor designed concrete grade 3F52 (was grade 3A32 concrete).

Partial depth Type B repairs traditionally utilized MnDOT designed concrete grade 3U18. Type B repairs will remain unchanged and require MnDOT designed concrete grade 3U18. The individual material weights (mix design) for bagged 3U18 are stated in MnDOT Standard Specifications 3105. The contractor can also batch and mix 3U18 on site utilizing a mobile mixer. Batch weights for the mobile mixer are stated in 2302 CPR Special Provision.

DESIGNER NOTES:

1. Determination of whether to seal joints and cracks on repair projects.

If a roadways speed limit is **50 mph or greater**, the Concrete Engineering Unit recommends **not** resealing joints and cracks outside the limits of the **Type B & C** repairs.

2. Use of HV vs. LV Designations:

- (a) Details that contain the HV (High Volume) designation are for state projects on Interstate highways or Trunk highways.
- (b) Details that contain LV (Low Volume) designation are for State Aid Projects and Local Aid Projects Only. However, State/Local Aid projects can also utilize



repair details designated as HV.

(c) Contact the Concrete Engineering Unit if you have questions about the HV vs. LV designation and the proper application of the CD-LV versus CD-HV Full Depth repairs.

(d) Repairs that do not contain the LV or HV extensions are suited for all projects.

CONCRETE REHABILITATION STANDARDS LOCATION:

The Concrete Rehabilitation Standards are in a Microstation V8 (*.dgn) file and are available for downloading as boilerplates on the Concrete Office website at:

<http://www.dot.state.mn.us/materials/concretepavement.html>.

There is also an Adobe Acrobat (*.pdf) file of the Concrete Rehabilitation Standards available on the website for viewing and printing purposes. There is not currently a Metric version of the Concrete Pavement Rehabilitation Standards.

SPECIAL PROVISIONS LOCATION:

To obtain the Special Provisions for CPR (which include method of measurement and basis of payment), dowel bar retrofit, or concrete grinding, you will need to go to the MnDOT Special Provisions Website and download from the SP2016 file.

<http://www.dot.state.mn.us/pre-letting/prov/index.html>

- SP2016-122 ~ (2302) Concrete Pavement Rehabilitation (CPR)
- SP2016-123 ~ (2302) Concrete Grinding (**with Ride Incentives**)
- SP2016-124 ~ (2302) Concrete Grinding (**without Ride Incentives**)
- SP2016-39 ~ (1717) Air, Land and Water Pollution (Concrete Grinding)***

*****Always include Provision (1717) on projects using either SP2016-123 or SP2016-124**

If you have any questions regarding CPR, please contact Gordy Bruhn at 651-366-5523 or myself.

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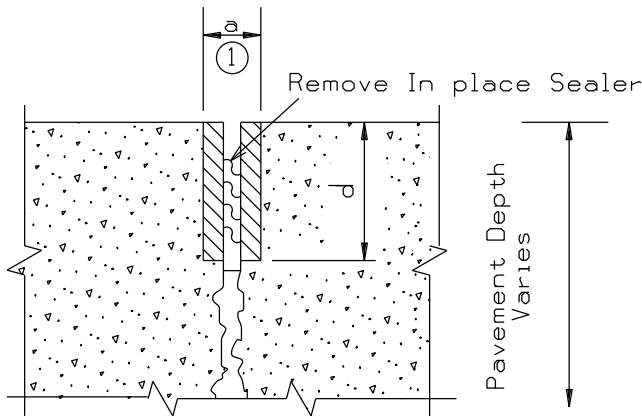


VARIABLE WIDTH JOINT CRACK REPAIR / JOINT REPAIR (TYPE A1)

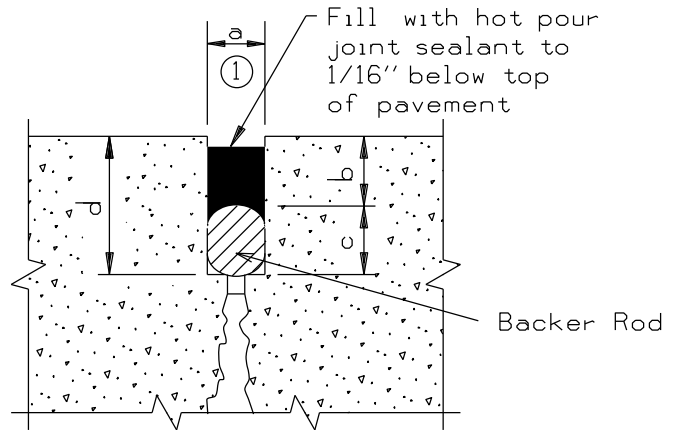
DESCRIPTION: IN NEWLY CONSTRUCTED REPAIRS OR IN PLACE JOINTS OR CRACKS.

SAW, CLEAN, SEAL TRANSVERSE AND / OR LONGITUDINAL PAVEMENT JOINTS OR CRACKS.

SECTION REMOVAL



SECTION INSTALLATION



 AREA TO BE REMOVED BY SAWING, IN PLACE JOINT OR CRACK MAY CONTAIN JOINT SEALER

NOTES

- * On roadways with posted speed limits of 45 mph or greater the maximum recommended "a" dimension is $\frac{5}{8}$ inch. ①

JOINT WIDTH (INCHES)	SEALANT BEAD THICKNESS (INCHES)	BACKER ROD DIAMETER (INCHES)	MINIMUM JOINT DEPTH (INCHES)	ESTIMATED QUANTITY (ft/gal)	ESTIMATED QUANTITY (lb/lf)
a	b	c	d	(ft/gal)	(lb/lf)
1/4	1/4	3/8	11/16	268	0.035
3/8	3/8	1/2	15/16	119	0.079
1/2	1/2	5/8	1-3/16	67	0.140
5/8	5/8	3/4	1-7/16	43	0.219
3/4	3/4	7/8	1-11/16	30	0.316
7/8	7/8	1.0	1-15/16	22	0.430
1.0	1.0	1-1/8	2-3/16	17	0.562
1-1/8	1-1/8	1-1/4	2-7/16	13	0.711
1-1/4	1-1/4	1-3/8	2-11/16	11	0.877

WORK TO BE DONE

1. Remove in place joint sealant, if applicable.
2. Saw both joint faces to configuration shown then immediately water flush the joint or crack.
3. Clean and dry joint or crack by sandblasting and air blasting.
4. Furnish and install backer rod of appropriate diameter in joint or crack opening. Furnish and install backer rod when joints are $\frac{1}{4}$ " wide or greater.
5. Fill joint or crack with Joint and Crack Sealer (Specification 3725 Hot Poured).
6. To prevent tracking of the Joint and Crack Sealer use tissue paper if necessary.

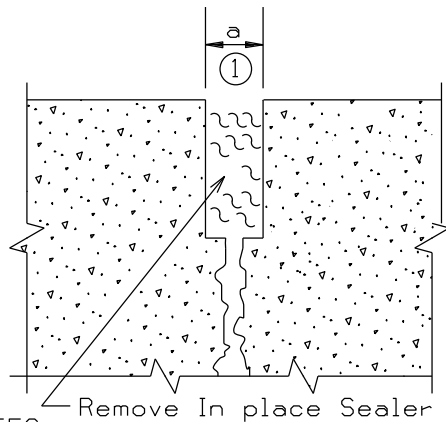
BASIS OF PAYMENT

2302 Joint Repair (Type A1)
(Lin. Ft.)

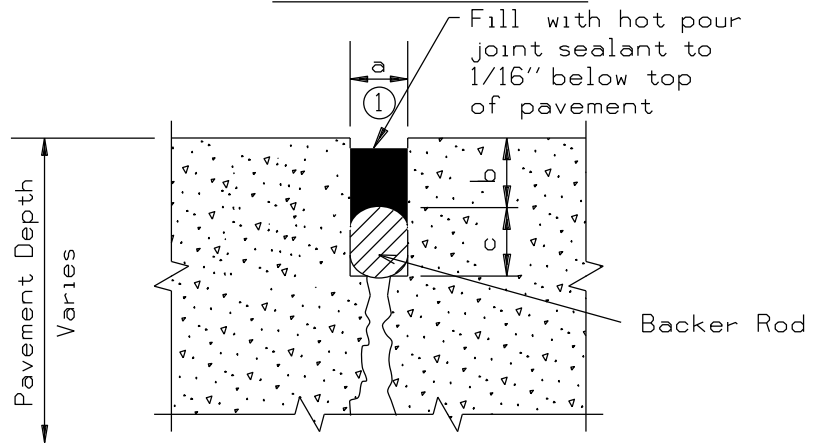
VARIABLE WIDTH IN PLACE JOINT OR CRACK REPAIR / JOINT REPAIR (TYPE A2)

DESCRIPTION: REMOVE IN PLACE JOINT SEALER, CLEAN AND SEAL TRANSVERSE AND / OR LONGITUDINAL PAVEMENT JOINTS OR CRACKS.

SECTION REMOVAL



SECTION INSTALLATION



NOTES

- * On roadways with posted speed limits of 45 mph or greater the maximum recommended "a" dimension is 3/4 inch. ①

JOINT WIDTH (INCHES)	SEALANT BEAD THICKNESS (INCHES)	BACKER ROD DIAMETER (INCHES)	MINIMUM JOINT DEPTH (INCHES)	ESTIMATED QUANTITY (ft/gal)	ESTIMATED QUANTITY (lb/lf)
a	b	c	d	(ft/gal)	(lb/lf)
1/4	1/4	3/8	11/16	268	0.035
3/8	3/8	1/2	15/16	119	0.079
1/2	1/2	5/8	1-3/16	67	0.140
5/8	5/8	3/4	1-7/16	43	0.219
3/4	3/4	7/8	1-11/16	30	0.316
7/8	7/8	1.0	1 15/16	22	0.430
1.0	1.0	1 1/8	2 3/16	17	0.562
1 1/8	1 1/8	1 1/4	2 7/16	13	0.711
1 1/4	1 1/4	1 3/8	2 11/16	11	0.877

WORK TO BE DONE

BASIS OF PAYMENT

1. Remove in place joint sealant, if applicable.
2. Clean and dry joint or crack by sandblasting and air blasting.
3. Furnish and install backer rod of appropriate diameter in joint or crack opening. Furnish and install backer rod when joints are 1/4" wide or greater.
4. Fill joint or crack with Joint and Crack Sealer (Specification 3725 Hot Poured).
5. To prevent tracking of the Joint and Crack Sealer use tissue paper if necessary.

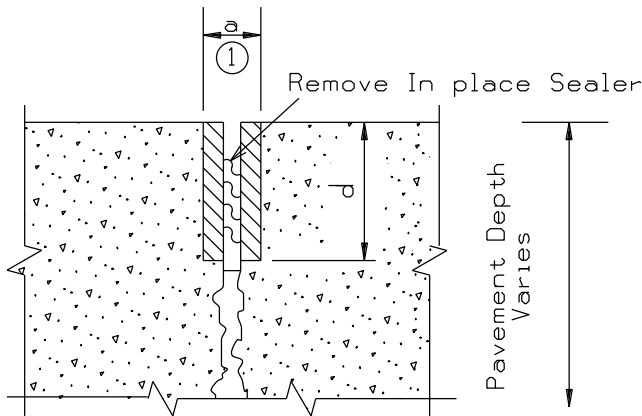
2302 Joint Repair (Type A2)
(Lin. Ft.)

VARIABLE WIDTH JOINT CRACK REPAIR / JOINT REPAIR (TYPE A1)

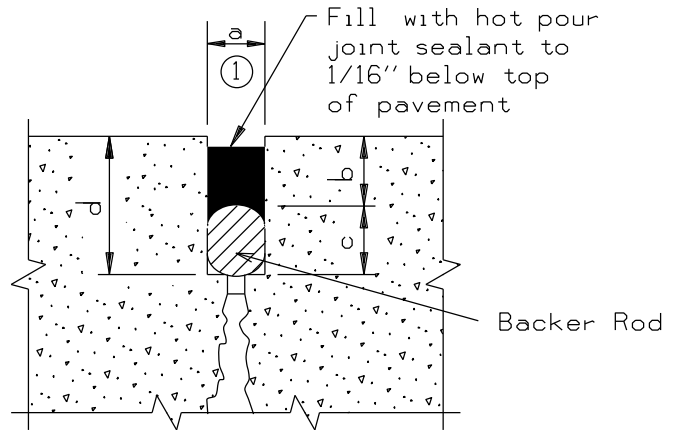
DESCRIPTION: IN NEWLY CONSTRUCTED REPAIRS OR IN PLACE JOINTS OR CRACKS.

SAW, CLEAN, SEAL TRANSVERSE AND / OR LONGITUDINAL PAVEMENT JOINTS OR CRACKS.

SECTION REMOVAL



SECTION INSTALLATION



 AREA TO BE REMOVED BY SAWING, IN PLACE JOINT OR CRACK MAY CONTAIN JOINT SEALER

NOTES

- * On roadways with posted speed limits of 45 mph or greater the maximum recommended "a" dimension is $\frac{5}{8}$ inch. ①

JOINT WIDTH (INCHES)	SEALANT BEAD THICKNESS (INCHES)	BACKER ROD DIAMETER (INCHES)	MINIMUM JOINT DEPTH (INCHES)	ESTIMATED QUANTITY (ft/gal)	ESTIMATED QUANTITY (lb/lb)
a	b	c	d	(ft/gal)	(lb/lb)
1/4	1/4	3/8	11/16	268	0.035
3/8	3/8	1/2	15/16	119	0.079
1/2	1/2	5/8	1-3/16	67	0.140
5/8	5/8	3/4	1-7/16	43	0.219
3/4	3/4	7/8	1-11/16	30	0.316
7/8	7/8	1.0	1-15/16	22	0.430
1.0	1.0	1-1/8	2-3/16	17	0.562
1-1/8	1-1/8	1-1/4	2-7/16	13	0.711
1-1/4	1-1/4	1-3/8	2-11/16	11	0.877

WORK TO BE DONE

1. Remove in place joint sealant, if applicable.
2. Saw both joint faces to configuration shown then immediately water flush the joint or crack.
3. Clean and dry joint or crack by sandblasting and air blasting.
4. Furnish and install backer rod of appropriate diameter in joint or crack opening. Furnish and install backer rod when joints are $\frac{1}{4}$ " wide or greater.
5. Fill joint or crack with Joint and Crack Sealer (Specification 3725 Hot Poured).
6. To prevent tracking of the Joint and Crack Sealer use tissue paper if necessary.

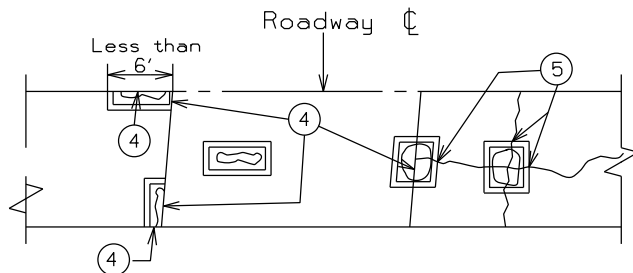
BASIS OF PAYMENT

Incidental

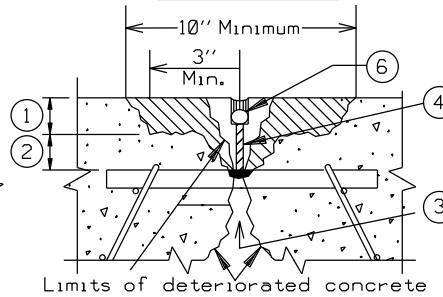
PARTIAL DEPTH REPAIR (TYPE BA)

DESCRIPTION: REMOVE CONCRETE, REESTABLISH JOINTS AND CRACKS, FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS AND CRACKS.

PLAN VIEW



PROFILE VIEW



AREA TO BE REMOVED
10" Min. Dimension
(Width & Length)

NOTES

- * Joint and crack reestablishment is required. Furnish and install preformed joint filler prior to concrete placement.
- * Sawing for the initial joint establishment is not allowed.
- * Furnish preformed joint filler of a width equal to the existing transverse joint or crack $\frac{1}{4}$ " minimum thickness (Standard Spec. 3702). (4) Wax coated cardboard is allowed on cracks that are $\frac{1}{4}$ " or less in width. (5)
- * Chipping hammers are limited to a maximum weight of 35 pounds.

WORK TO BE DONE

1. Remove all concrete to limits shown in detail, including all unsound concrete by milling (1) and chipping hammers. (2) Taper all sides of the repair 30° - 60° from vertical and to a minimum depth of 2". (1)
2. If the end of the dowel bar is exposed, remove the dowel.
3. Clean exposed surface by sandblasting and air blasting
4. Place duct tape as a bond breaker on exposed dowel bars.
5. Provide joint compression relief in the void below the exposed dowel bar by furnishing and placing clean concrete sand level with the top of the dowel bars. (3)
6. Provide joint compression relief above the dowel bars by furnishing and installing preformed joint filler. (4)

AND / OR

Reestablish the crack through the repair by furnishing and installing wax coated cardboard. (5)

7. Apply bonding grout immediately prior to concrete placement. Re-sandblast and air blast if the bonding grout dries before the concrete is placed.

AND / OR

The Contractor may use water to precondition the in place concrete prior to placing concrete backfill. Reapply water if concrete dries prior to placing concrete backfill.

8. Furnish & place Concrete Mix Number 3U18. Vibrate, finish to grade and slope, edge adjacent to joint filler, Seal edges with grout and apply cure.
9. Saw and seal joints and cracks in accordance with. Joint Repair (Type A1) detail. (6) (Incidental)

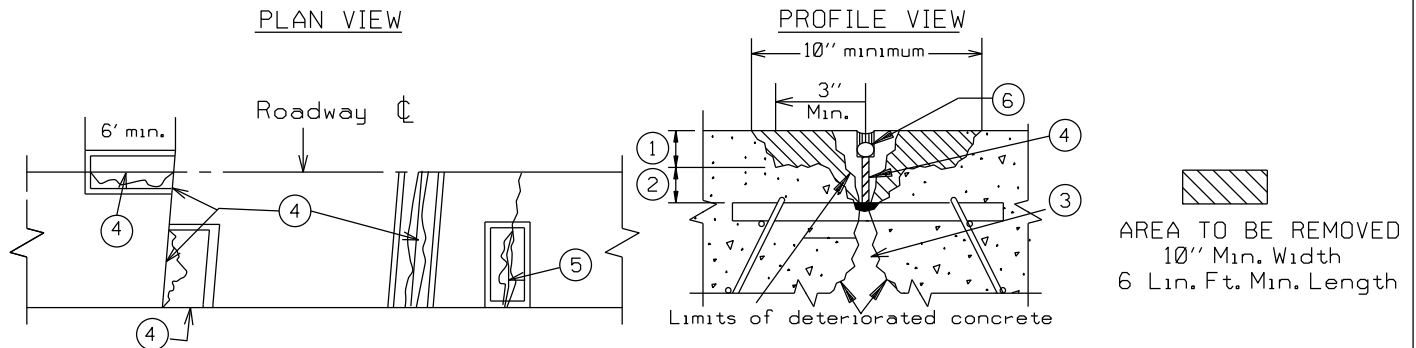
BASIS OF PAYMENT

2302

Partial Depth Repair
(Type BA) (Sq. Ft.)

JOINT AND CRACK REPAIR (TYPE B3)

DESCRIPTION: REMOVE CONCRETE, REESTABLISH JOINTS AND CRACKS, FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS AND CRACKS.



NOTES

- * Joint and crack reestablishment is required. Furnish and install preformed joint filler prior to concrete placement.
- * Sawing for the initial joint establishment is not allowed when placed over random cracks.
- * Furnish preformed joint filler of a width equal to the existing transverse joint or crack $\frac{1}{4}$ " minimum thickness (Standard Spec. 3702). (4) Wax coated cardboard is allowed on cracks that are $\frac{1}{4}$ " or less in width. (5)
- * Chipping hammers are limited to a maximum weight of 35 pounds.

WORK TO BE DONE

BASIS OF PAYMENT

1. Remove all concrete to limits shown in detail, including all unsound concrete by milling (1) and chipping hammers. (2) Taper all sides of the repair 30° - 60° from vertical and to a minimum depth of 2". (1)
2. If the end of the dowel bar is exposed, remove the dowel.
3. Clean exposed surface by sandblasting and air blasting
4. Place duct tape as a bond breaker on exposed dowel bars.
5. Provide joint compression relief in the void below the exposed dowel bar by furnishing and placing clean concrete sand level with the top of the dowel bars. (3)
6. Provide joint compression relief above the dowel bars by furnishing and installing preformed joint filler. (4)

AND / OR

- 6A. Reestablish the crack through the repair by furnishing and installing wax coated cardboard. (5)
7. Apply bonding grout immediately prior to concrete placement. Re-sandblast and air blast if the bonding grout dries before the concrete is placed.

AND / OR

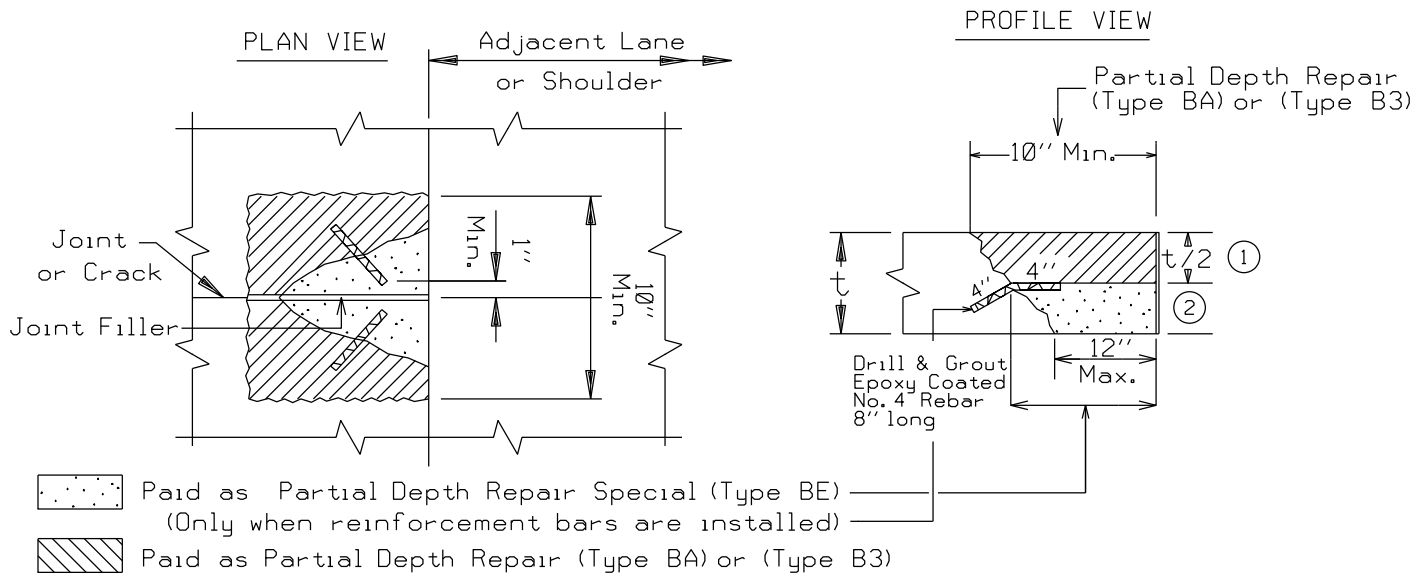
The Contractor may use water to precondition the in place concrete prior to placing concrete backfill. Reapply water if concrete dries prior to placing concrete backfill.

8. Furnish & place Concrete Mix Number 3U18. Vibrate, finish to grade and slope, edge adjacent to joint filler, Seal edges with grout and apply cure.
9. Saw and seal joints and cracks in accordance with. Joint Repair (Type A1) detail. (6) (Incidental)

2302 Joint and Crack repair (Type B3) (Lin. Ft.)

PARTIAL DEPTH REPAIR SPECIAL (TYPE BE)

DESCRIPTION: REMOVE CONCRETE, INSTALL REINFORCEMENT BARS, FURNISH & PLACE CONCRETE, SAW AND SEAL JOINTS.



NOTES

- * Do not use this repair in the wheel paths, use the Full Depth Repair (Type CD).
- * Joint and crack reestablishment is required. Furnish and install preformed joint filler prior to concrete placement.
- * Sawing for the initial joint establishment is not allowed.
- * Furnish joint filler in a single piece for the full depth of the repair.
- * Furnish preformed joint filler of a width equal to the existing transverse joint or cracks $\frac{1}{4}$ " minimum thickness (Standard Spec. 3702). Wax coated cardboard is allowed on cracks that are $\frac{1}{4}$ " or less in width.
- * Chipping hammers are limited to a maximum weight of 35 pounds.

WORK TO BE DONE

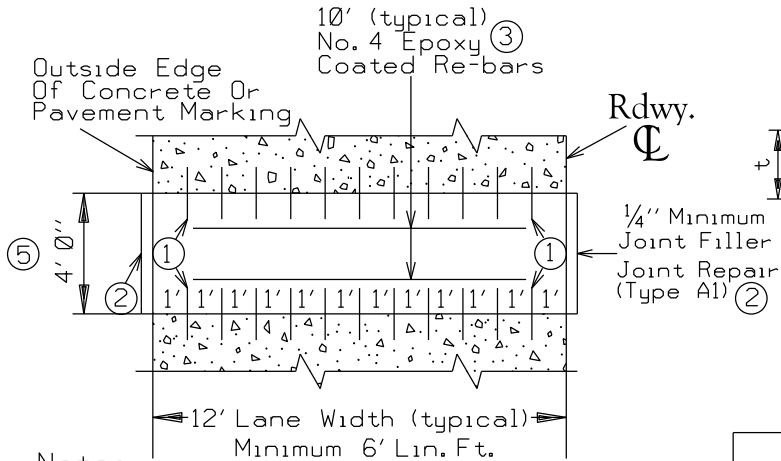
BASIS OF PAYMENT

- See Partial Depth Repair (Type BA) or Crack and Joint Repair (Type B3) details for additional information. - Remove all concrete to limits shown in the details, including all unsound concrete, by milling ① and chipping hammers. ② - Remove in place reinforcement bars and dowel bars as needed. - Clean exposed surface by sandblasting and air blasting. - Drill & grout reinforcement bars. - Reestablish the crack through the repair by furnishing and installing wax coated cardboard. - Apply bonding grout immediately prior to concrete placement. Re-sandblast and air blast if the bonding grout dries before the concrete is placed.	2302 Partial Depth Repair (Type BA) (Sq. Ft.) OR 2302 Crack and Joint Repair (Type B3) (Lin. Ft.)
AND / OR	
- The Contractor may use water to precondition the in place concrete prior to placing concrete backfill. Reapply water if concrete dries prior to placing concrete backfill. - Furnish, place, and vibrate Concrete Mix No. 3U18.	2302 Partial Depth Repair Special (Type BE) (Sq. Ft.) (1 Sq. Ft. Minimum)

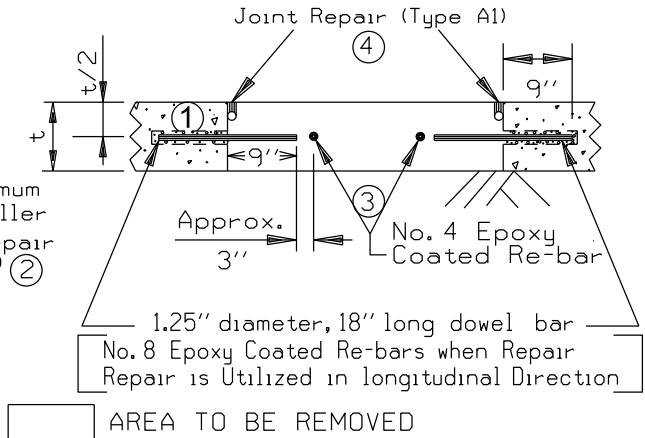
FULL DEPTH REPAIR (TYPE CD-HV)

DESCRIPTION: REMOVE CONCRETE, PLACE REINFORCEMENT BARS AND DOWELS, FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS.

PLAN VIEW



PROFILE VIEW



Notes

- * When repairing random cracks on newly constructed concrete pavements, contact the Concrete Engineering Unit for recommendations.
- * This repair is also used on tied longitudinal joints (2' on each side of the joint). Replace dowels with 18" long No. 8 epoxy coated reinforcement bars. Furnish and install reinforcement bars (epoxy coated) at 1' Centers. Install 1/2" joint filler at the up and down stream ends of the longitudinal repair. ②
- * Add an additional dowel bar per side for each 1 foot increase in lane width/pay quantity.
- * Drill in place pavement utilizing drill bit(s) with a stated or measured diameter of of at least one eighth inch larger diameter than D&G dowel bar/re-bar diameter. ①
- * If repair is placed over an existing skewed contraction joint, match existing contraction joint skew, unless otherwise allowed by the Engineer.
- * No. 4 epoxy coated re-bar ③ length is equal to the width of the repair, minus 2 feet.

WORK TO BE DONE

1. Saw cut to full depth and remove concrete pavement. Restore and compact in place base.
2. Drill in place concrete pavement for dowels bars or epoxy coated reinforcement bars on longitudinal repairs. ①
3. Furnish and install dowels or reinforcement bars. Secure the dowel bars or reinforcement bars to the in place concrete by using an approved non shrink grout or epoxy adhesive. Coat free end of dowel bars with form coating material meeting Spec. 3902. ①
4. Clean the vertical surfaces of the in place concrete.
5. Furnish and install joint filler. ②
6. Furnish and place Concrete Mix Number 3R52.
7. Furnish and install reinforcement bars in plastic concrete, 3" from end of dowel bar at mid depth. ③
8. Vibrate, finish to grade and slope, edge, texture, and apply cure.
9. Saw and seal joints in accordance with Joint Repair (Type A1) detail. ② ④ (Incidental)

Basis of Payment

2302 Full Depth Repair
(Type CD-HV) (Lin. Ft.)

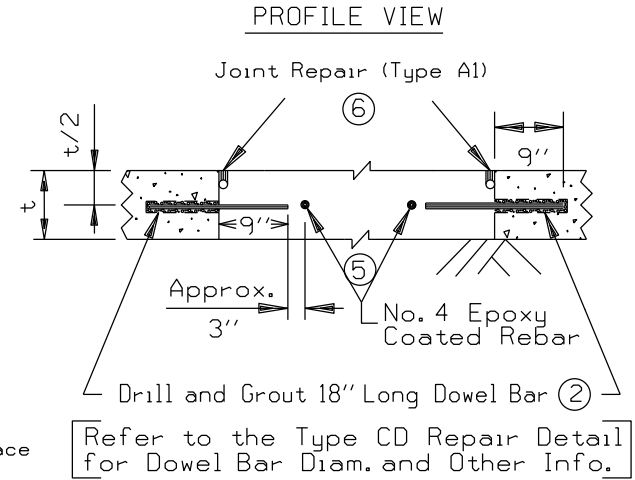
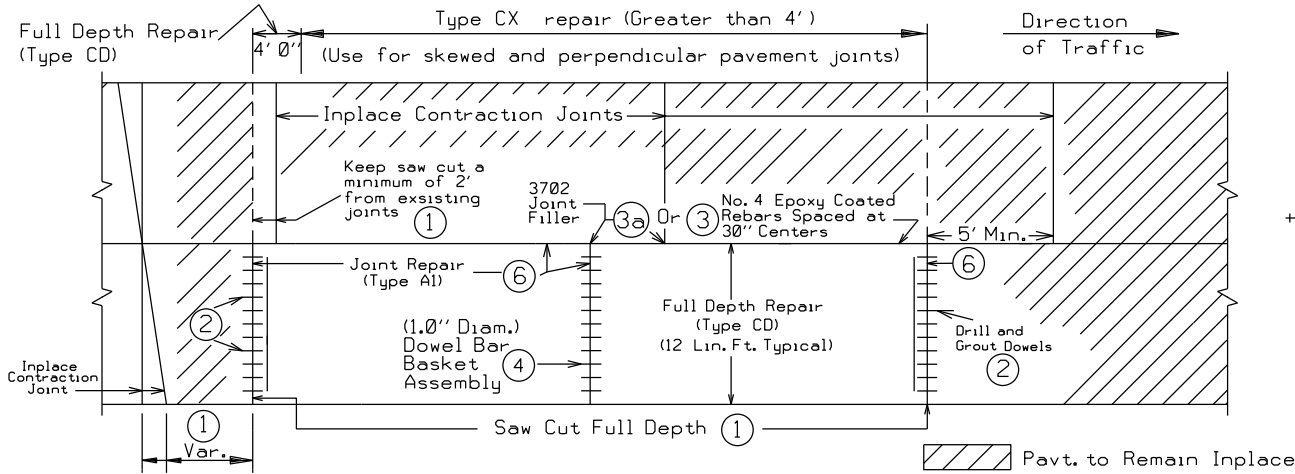
Note

Measurement for payment is made along a single transverse saw cut.

If this repair is placed at a skew, the standard 4 foot dimension is measured perpendicular from the saw cut. (5)

PAVEMENT REPLACEMENT (TYPE CX)

DESCRIPTION: REMOVE CONCRETE, RESTORE AND COMPACT BASE, PLACE DOWELS AND REINFORCEMENT BARS, FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS.



Notes

- * Place saw cut at least 2' up stream or 5' down stream from any transvers joints in the adjacent lane.
- * Drill concrete pavement utilizing a drill bit diameter an > 1/8-inch larger than dowel/re-bar bar diameter. (2)
- * Dowel bar required when longitudinal length of the repair is > 15'. Place dowel bar assemblies at 15' centers, when repair length exceeds 30'. (4)

WORK TO BE DONE

1. See Full Depth Repair (Type CD) for additional information.
2. Saw full depth & remove in place concrete pavement. Restore and compact in place base. (1)
3. Drill in place concrete for dowel bars. Eliminate inside 5 dowels for (Type CD-LV) repairs. (2)
4. Furnish and install dowels. Secure dowels to the in place concrete with a approved non shrink grout or epoxy adhesive. (2) Coat free end of dowels with a form coating material meeting Spec. 3902.
5. If matching in place transverse joints, drill and grout epoxy coated tie bars into the adjacent lane. Drill and grout reinforcement bars not require if repair length is under 75'. (3)
- OR
- 5a. Isolate all transverse pavement joints and cracks. Furnish and install joint filler 3702 between the adjacent in place lane and the (Type CX) repair. (3a) (Incidental)
6. As needed, furnish (1.0" Diam.) Dowel Bar Assemblies, in accordance with Standard Plate 1103. (4)
7. Clean vertical surfaces of in place concrete.
8. Place epoxy coated supplemental reinforcing bars over culverts as needed, See Standard Plate 1070.
9. Furnish and place Concrete Mix Number 3R52.
10. Furnish and install epoxy coated rebars in conc. repair, located 3" from end of dowel bar. (5)
11. Vibrate, finish to grade and slope, edge, texture, and apply cure.
12. Green saw joints over dowel bar baskets. (4)
13. Saw and seal joints in accordance with Joint Repair (Type AI) detail. (6) (Incidental)

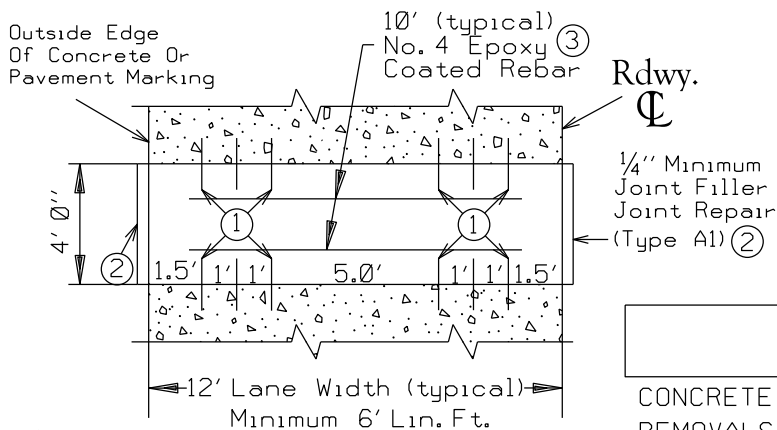
BASIS OF PAYMENT

- 2302 Full Depth Repair (Type CD) (Lin. Ft.)
- 2302 Drill and Grout Reinforcement Bars (Epoxy Coated) (Each)
- 2302 Dowel Bar (Each)
- 2302 Supplemental Reinforcement Bars (Epoxy Coated) (Pound)
- 2302 Pavement Replacement (Type CX) (Sq. Yd.)

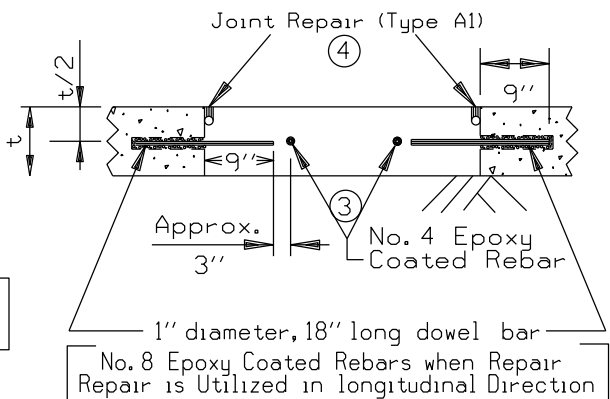
FULL DEPTH REPAIR (TYPE CD-LV)

DESCRIPTION: REMOVE CONCRETE, PLACE REINFORCEMENT BARS AND DOWELS, FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS.

PLAN VIEW



PROFILE VIEW



Notes

- * When repairing random cracks on newly constructed concrete pavements, contact the Concrete Engineering Unit for recommendations.
- * When the roadway width is 16' or greater, add an additional set of 4 dowels. Install additional dowels at mid point of the roadway.
- * Drill in place pavement utilizing drill bit(s) with a stated or measured diameter of of at least one eighth inch larger in diameter than D&G dowel/re-bar diameters. (1)
- * This repair is also used on tied longitudinal joints (2' on each side of the joint). Replace dowels with 18" long No. 8 epoxy coated reinforcement bars. Furnish and install reinforcement bars (epoxy coated) at 2' Centers. Install 1/2" joint filler at the up and down stream ends of the longitudinal repair. (2)
- * If repair is placed over an existing skewed contraction joint, match existing contraction joint skew, unless otherwise allowed by the Engineer.
- * No. 4 epoxy coated rebar (3) length is equal to the width of the repair, minus 2 feet.

WORK TO BE DONE

1. Saw cut to full depth and remove concrete pavement. Restore and compact in place base.
2. Drill in place concrete pavement for dowels or epoxy coated reinforcement bars longitudinal repairs. (1)
3. Furnish and install dowels or reinforcement bars. Secure the dowel bars or reinforcement bars to the in place concrete by using an approved non shrink grout or epoxy adhesive. Coat free end of dowel bars with form coating material meeting Spec. 3902. (1)
4. Clean the vertical surfaces of the in place concrete.
5. Furnish and install joint filler. (2)
6. Furnish and place Concrete Mix Number 3R52.
7. Furnish and install reinforcement bars in plastic concrete, 3" from end of dowel bar at mid depth. (3)
8. Vibrate, finish to grade and slope, edge, texture, and apply cure.
9. Saw and seal joints in accordance with Joint Repair (Type A1) detail. (2) (4) (Incidental)

BASIS OF PAYMENT

2302 Full Depth Repair
(Type CD-LV) (Lin. Ft.)

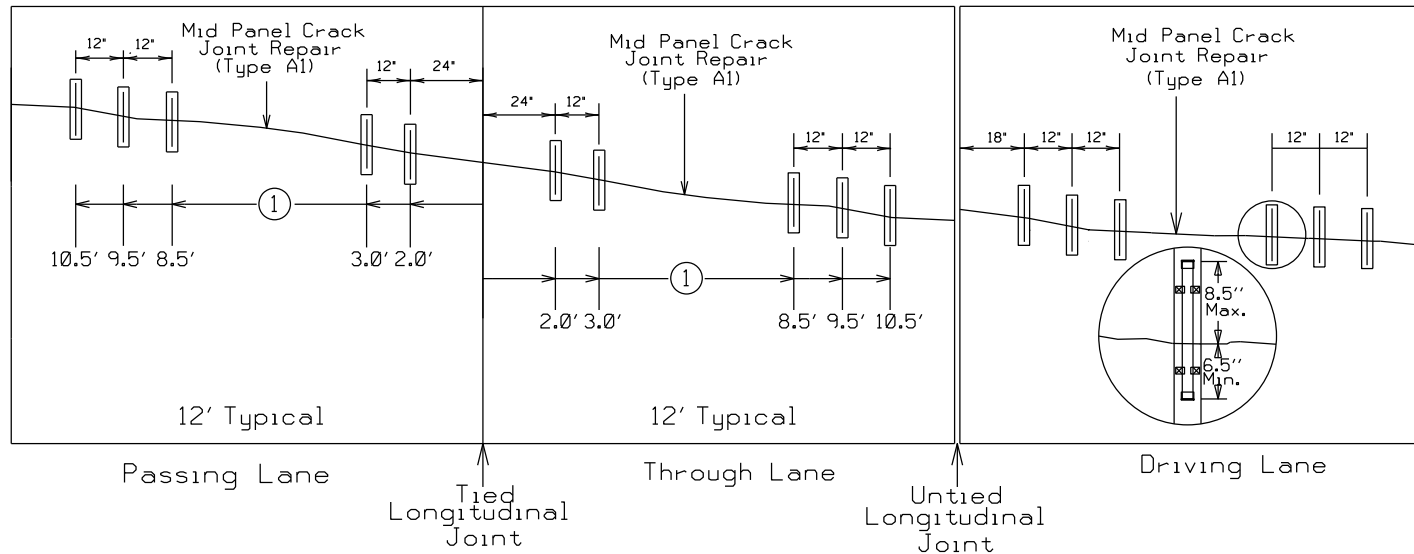
DOWEL BAR RETROFIT

DESCRIPTION: THIS REPAIR IS INTENDED TO BE USED TO ESTABLISH/RESTORE LOAD TRANSFER AT TRANSVERSE JOINTS OR CRACKS.

Sheet 1 of 2

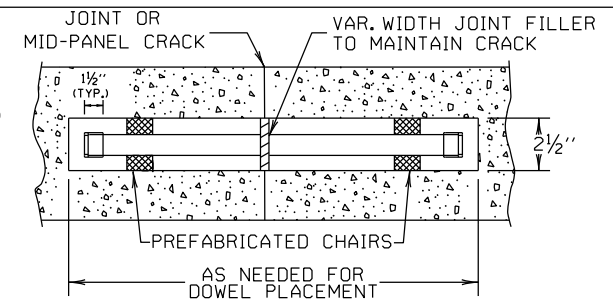
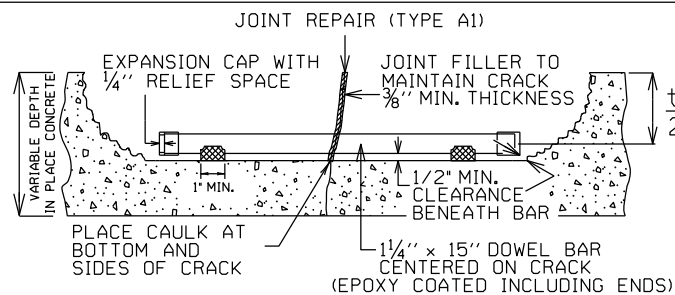
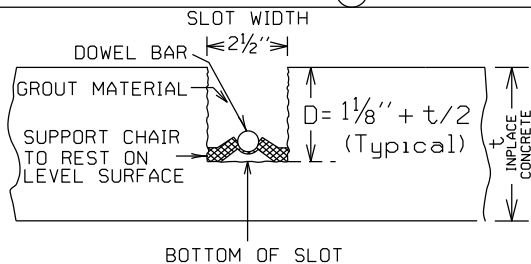
PLAN VIEW

TYPICAL DOWEL BAR RETROFIT LAYOUT



Notes:

- * Not recommended for cracks that are $\frac{3}{4}$ " or greater in width, use Full Depth Repair (Type CD)
- * Chipping hammers are limited to a maximum weight of 35 pounds.
- * Move retrofit dowels as needed to avoid in place dowel bars.
- * Always measure from the roadway center line for dowel bar offsets. ①
- * For pavements of 8" or under contact the Concrete Engineering Unit for dowel bar depth and minimum cover recommendations. ②

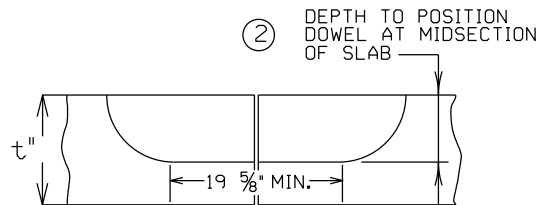


DOWEL BAR RETROFIT DETAILS

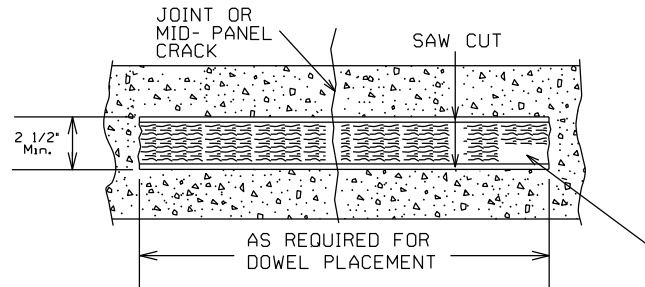
Sheet 2 of 2

STEP 1

SAW SLOT FOR EACH DOWEL BAR.
(AVOID IN- PLACE DOWEL BARS)

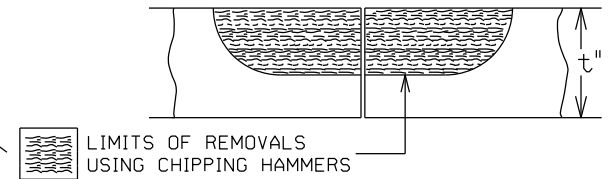


STEP 1 AND 2 PLAN VIEW



STEP 2

REMOVE CONCRETE BETWEEN SAW CUTS,
INCLUDING CONCRETE TO FORM KERF.

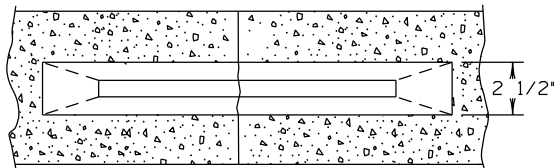


STEP 3

CLEAN EXPOSED SURFACES INSIDE THE
SLOT BY SANDBLASTING, AIR BLASTING,
AND VACUUM.

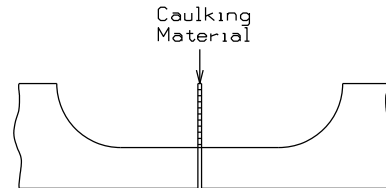
NOTE

CONTINUE TO SANDBLAST UNTIL THE VERTICAL
SIDES ARE ROUGH TO THE TOUCH.



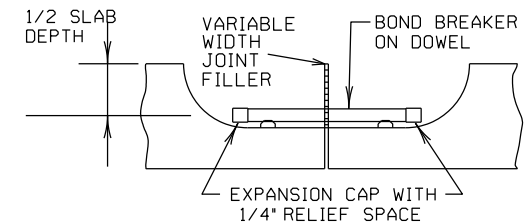
STEP 4

TO KEEP THE PATCHING MATERIAL FROM
LEAKING INTO THE JOINT OR CRACK.
SEAL THE CRACK WITHIN THE SLOT
WITH CAULKING MATERIAL. PLACE THE
JOINT FILLER IN CONJUNCTION WITH
THE CRACK SEALER.



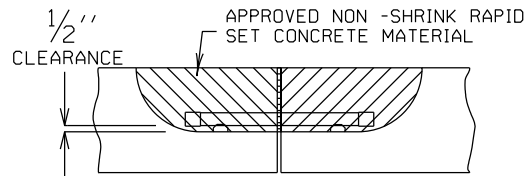
STEP 5

FURNISH AND INSTALL DOWEL BARS
ALIGN DOWELS PARALLEL WITH THE PAVEMENT
SURFACE AND CENTERLINE OF THE ROADWAY.
FURNISH AND INSTALL JOINT FILLER TO
MAINTAIN CRACK THROUGH THE SLOT.



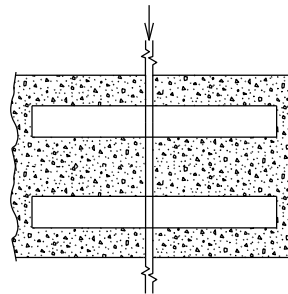
STEP 6

MOISTEN INSIDE OF SLOT WITH WATER.
(STANDING WATER IS NOT ALLOWED)
FURNISH AND PLACE APPROVED NON -SHRINK
RAPID SET CONCRETE MATERIAL FOR DOWEL BAR
RETROFIT REPAIRS, AND APPLY CURE.
(EDGING ONLY REQUIRED ALONG THE JOINT FILLER)



STEP 7

SAW AND SEAL THE JOINT OR CRACK THE ENTIRE
ENTIRE WIDTH OF THE LANE IN ACCORDANCE WITH
WITH JOINT REPAIR (TYPE A1) (INCIDENTAL)



BASIS OF PAYMENT

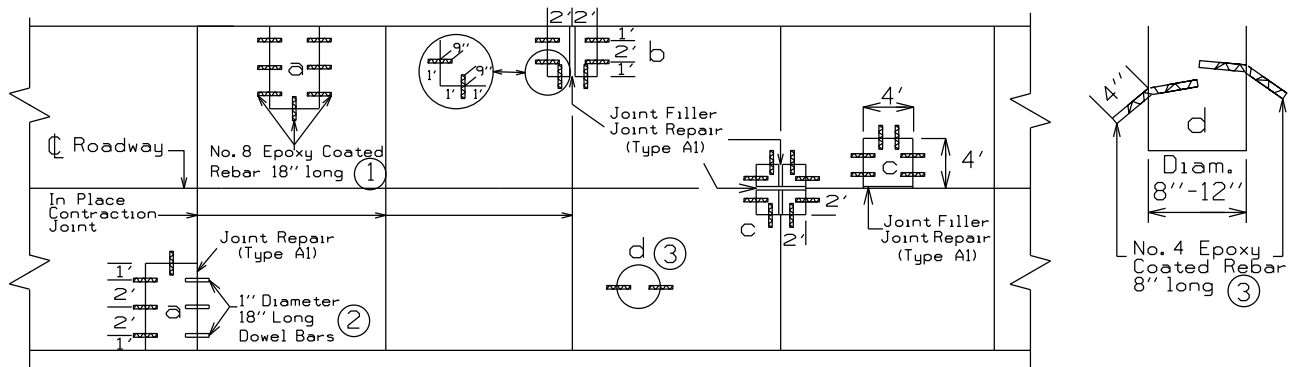
2302 RETROFIT DOWEL BAR (EACH)

SPOT FULL DEPTH REPAIR TYPE (C1-LV)

DESCRIPTION: SAW CONCRETE, REMOVE CONCRETE. PLACE REINFORCING AND DOWELS AS REQUIRED. FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS.

PLAN VIEW

SECTION



Repair Dimensions

AREA TO BE REMOVED

- a) Exterior Edge, 3' 6" x 6' min. for a one half lane repair.
- b) Exterior edge at a joint location, 4' x 4' min. size.
- c) Interior edge at centerline, 4' x 4' min. size.
- d) Gas line or exploratory core hole 4" diameter minimum size and 12" diameter maximum size.

Notes

- * Drill in place pavement utilizing drill bit(s) with a stated or measured diameter of of at least one eighth inch larger in diameter than D&G dowel/re-bar diameters. (1)(2)(3)

WORK TO BE DONE

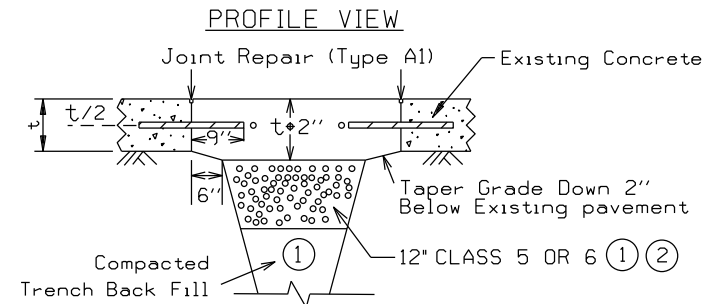
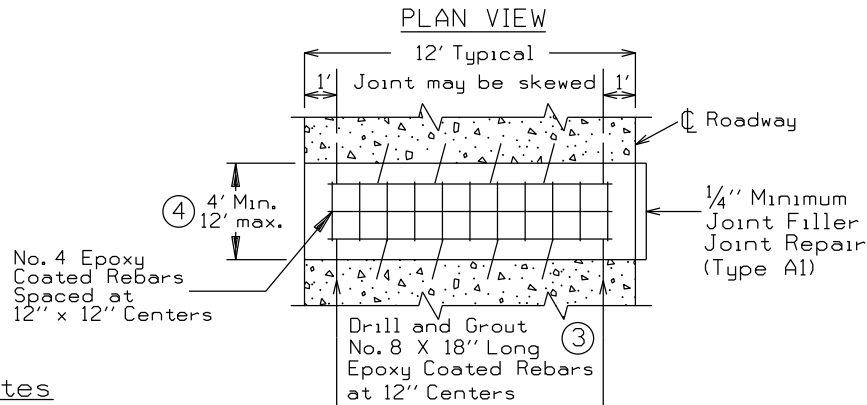
BASIS OF PAYMENT

1. Saw cut to full depth and remove concrete pavement. Restore and compact in place base.
2. Drill in place concrete at 2' C. to C.: for No. 8 epoxy coated reinforcement bars (1) or, 1" dowel bars (2) or, No. 4 epoxy coated reinforcement bars. (3)
3. Furnish and install epoxy coated reinforcement bars or dowel bars. Secure the reinforcement bars or dowel bars to the in place concrete by using an approved non shrink grout or epoxy adhesive. Coat free end of dowel bars with a form coating material meeting Specification 3902.
4. Clean the vertical surfaces of the in place concrete.
5. Furnish and install joint filler.
6. Furnish and place Concrete Mix Number 3R52 or furnish and place 3U18 for core hole "d" repairs.
7. Vibrate, finish to grade and slope, edge, texture, and apply cure.
8. Saw and seal joints in accordance with Joint Repair (Type A1) detail. (Incidental)

2302 Spot Full Depth Repair (Type C1-LV) (Sq. Ft.)

UTILITY TRENCH FULL DEPTH REPAIR (TYPE C2-LV)

DESCRIPTION: SAW FULL DEPTH AND REMOVE CONCRETE, FURNISH AND INSTALL REINFORCEMENT BARS, FURNISH AND PLACE CONCRETE, SAW OR FORM JOINTS, SAW AND SEAL JOINTS.



□ AREA TO BE REMOVED ▨ 12" CLASS 5 OR 6 (Incidental)

Notes

- * When the Type C2 repair is located within 2' of an existing contraction joint, widen the Type C2 repair as needed to remove the existing contraction joint. When a contraction joint is removed, replace the No. 8 epoxy coated rebar with 1" diameter dowels bars. Drill and grout dowels in accordance with the Full Depth Repair (Type CD-LV or CD-HV).
- * Check the plan for method of compaction. If a method of compaction is not stated in the plans use the quality compaction method in accordance with MnDOT Specification 2105. ①
- * Construct Class 5 or 6 aggregate base in accordance with MnDOT Specification 2211. Class 5 or 6 aggregate is incidental to the Utility Trench Full Depth Repair (Type C2). ②
- * Furnish and installed No. 8 reinforcement bars either straight or skewed at 20°. ③
- * When the length of the repair exceeds 12', Contact the Concrete Engineering Unit for recommendations. ④
- * Drill in place pavement utilizing drill bit(s) with a stated or measured diameter of ③ of at least one eighth inch larger in diameter than D&G dowel/re-bar diameters. ③

WORK TO BE DONE

1. Saw cut full depth and remove concrete pavement.
2. Excavate utility trench, back fill utility trench with in situ soils. Back fill trench to 14" below the bottom of existing pavement.
3. Furnish and place 12" class 5 or 6 aggregate base.
4. Drill in place concrete for No. 8 epoxy coated reinforcement bars.
5. Furnish and install epoxy coated reinforcement bars. Secure the reinforcement bars to the in place concrete with an approved non - shrink grout or epoxy adhesive.
6. Furnish and install preformed joint filler.
7. Furnish and install No. 4 epoxy coated supplemental steel spaced at 12" Centers
8. Furnish & place Concrete Mix Number 3R52. Vibrate, finish to grade and slope, edge forms and joint filler, apply texture and cure.
9. Saw and seal joints in accordance with Joint Repair (Type A1) detail. (Incidental)

BASIS OF PAYMENT

—2302 Utility Trench Full Depth Repair (Type C2-LV) (Sq. Yd.)

S.P. NO.

DATE: APRIL 22, 2016

SHEET

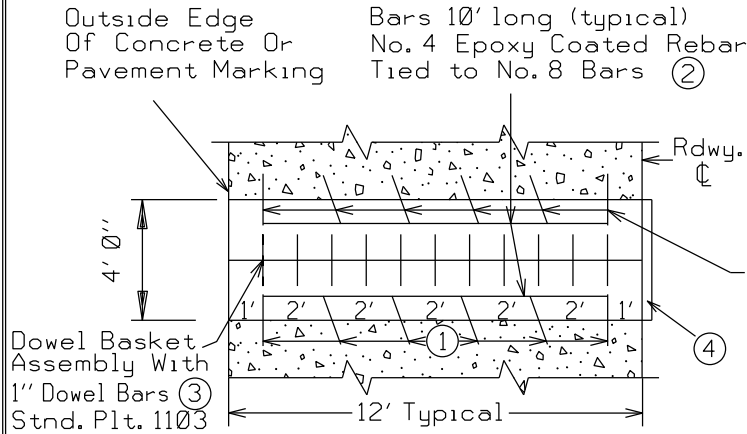
OF

SHEETS

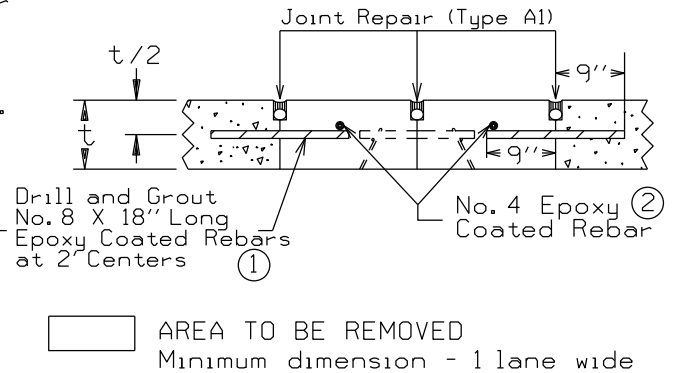
FULL DEPTH REPAIR (TYPE CA-LV)

DESCRIPTION: SAW CONCRETE, REMOVE CONCRETE. PLACE REINFORCING AND DOWELS BAR ASSEMBLY, FURNISH AND PLACE CONCRETE, SAW AND SEAL JOINTS.

PLAN VIEW



PROFILE VIEW



Notes

- * The Contractor may use the Full Depth Repair (Type CD-LV) in lieu of the Full Depth Repair (Type CA-LV).
- * The No. 8 reinforcement bars maybe skewed at 20° or straight at the discretion of the Contractor. (1)
- * Drill in place pavement utilizing drill bit(s) with a stated or measured diameter of of at least one eighth inch larger in diameter than D&G dowel/re-bar diameters. (1)
- * For skewed repairs, eliminate a tie bar at centerline edge with acute angle.
- * No. 4 epoxy coated rebar (2) length is equal to the width of the repair, minus 2 feet.

WORK TO BE DONE

BASIS OF PAYMENT

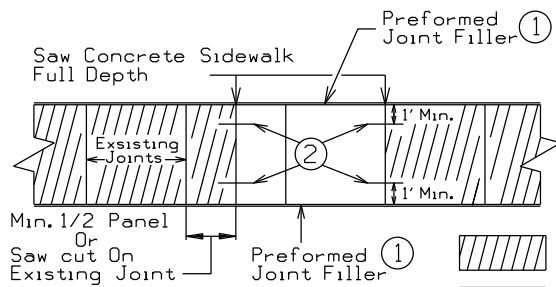
1. Saw cut to full depth and remove concrete pavement. Restore and compact in place base.
2. Drill in place concrete at 2' Centers for No. 8 epoxy coated reinforcement bars. (1)
3. Furnish and install epoxy coated reinforcement bars. Secure the reinforcement bars to the in place concrete by using an approved non shrink grout or epoxy adhesive. (1)
4. Furnish and install No. 4 epoxy coated reinforcing bars tied to the D&G No. 8 bars. (2)
5. Furnish and install dowel bar assembly with 1" diameter dowel bars. (3) Coat dowel bars with a form coating material meeting Spec. 3902
6. Furnish and install joint filler. (4)
7. Furnish and place Concrete Mix Number 3R52. Vibrate, finish to grade, slope, edge, texture, and apply cure.
8. Saw and seal joints in accordance with Joint Repair (Type A1) detail. (Incidental)

2302 Full Depth Repair (Type CA-LV), (lin. ft.)

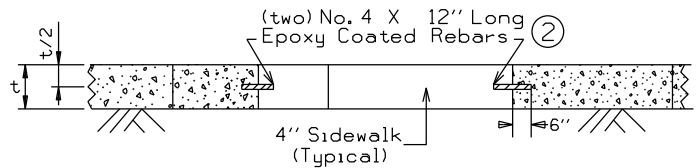
REPAIR SIDEWALK OR MEDIAN WALK

DESCRIPTION: REMOVE CONCRETE. RESTORE BASE. PLACE REINFORCING STEEL.
FURNISH AND PLACE CONCRETE. REFORM JOINTS AS NECESSARY.

PLAN VIEW



PROFILE VIEW



Notes

- * Place preformed joint filler when sidewalk is placed adjacent to concrete curb and gutter. See Standard Plate 7035 for further information on joint filler placement and joint layout. (1)
- * Where the sidewalk doubles as a driveway, place 6" Concrete Driveway Pavement for private driveways or 8" Concrete Driveway Pavement for commercial driveways. See Standard Plate 7035 for further information.

WORK TO BE DONE

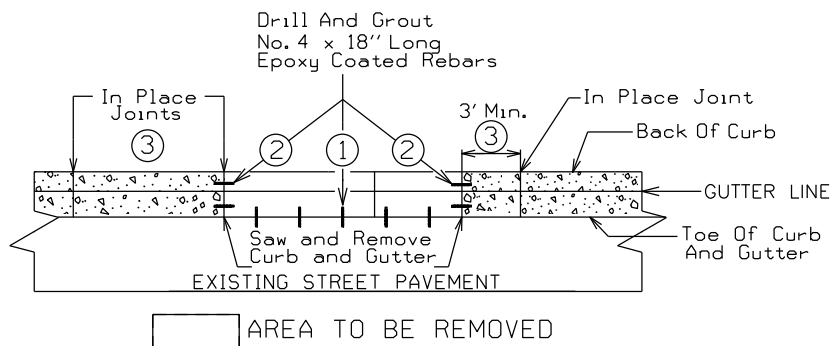
BASIS OF PAYMENT

1. Saw cut concrete walk full depth. (Incidental)	}	2104 Remove Sidewalk (Sq. Ft.)
2. Remove concrete sidewalk, restore and compact in place base.		
3. Drill in place concrete sidewalk for No. 4 epoxy coated reinforcement bars.	}	2302 Drill and Grout Reinforcement Bars (Epoxy Coated) (Each)
4. Furnish and install two epoxy coated reinforcement bars at each end of the removal area. Secure the reinforcement bars to the in place concrete by using an approved non shrink grout or epoxy adhesive. (2)		
5. Clean the vertical surfaces of the in place concrete.	}	2521 _____ inch Concrete Walk (Sq. Ft.) And / Or 2531 _____ inch Concrete Driveway Pavement (Sq. Yd.)
6. Furnish and install joint filler.		
7. Furnish and place Concrete Mix Number 3F52.		
8. Vibrate, finish to grade and slope, edge, texture, and apply cure.		
9. Restore joints by green sawing or hand tooling the plastic concrete to match the in place joint pattern.		

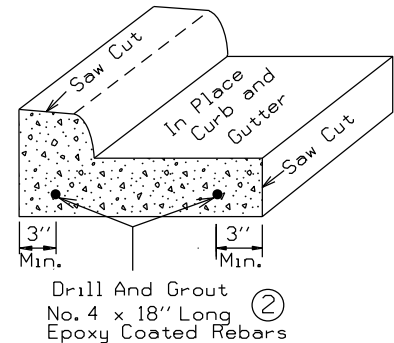
CURB AND GUTTER REPAIR

DESCRIPTION: REMOVE CONCRETE. RESTORE BASE. PLACE REINFORCING STEEL. FURNISH AND PLACE CONCRETE. REFORM JOINTS AS NECESSARY.

PLAN VIEW



CROSS SECTION VIEW



Notes

- * When the existing pavement is concrete, drill and grout reinforcement bars at 30" centers. ①
- * Locate saw cut to leave a minimum of 3' of in place curb and gutter between an existing joint and the proposed saw cut. If the 3' minimum can not be maintained, place the saw cut over the existing joint. ③

WORK TO BE DONE

1. Saw cut curb and gutter full depth. (Incidental)

2. Remove curb and gutter, restore and compact in place base.

3. Drill in place concrete pavement and curb and gutter for No. 4 epoxy coated reinforcement bars. ① ②

4. Furnish and install epoxy coated reinforcement bars. Secure the reinforcement bars to the in place concrete by using an approved non shrink grout or epoxy adhesive.

5. Clean the vertical surfaces of the in place concrete.

6. Furnish and place Concrete Mix Number 3F52.

7. Vibrate, finish to grade and slope, edge, texture, and apply cure.

8. Restore joints by green sawing or hand tooling the plastic concrete to match the in place joint pattern.

2104 Remove Concrete Curb and Gutter (Lin. Ft.)

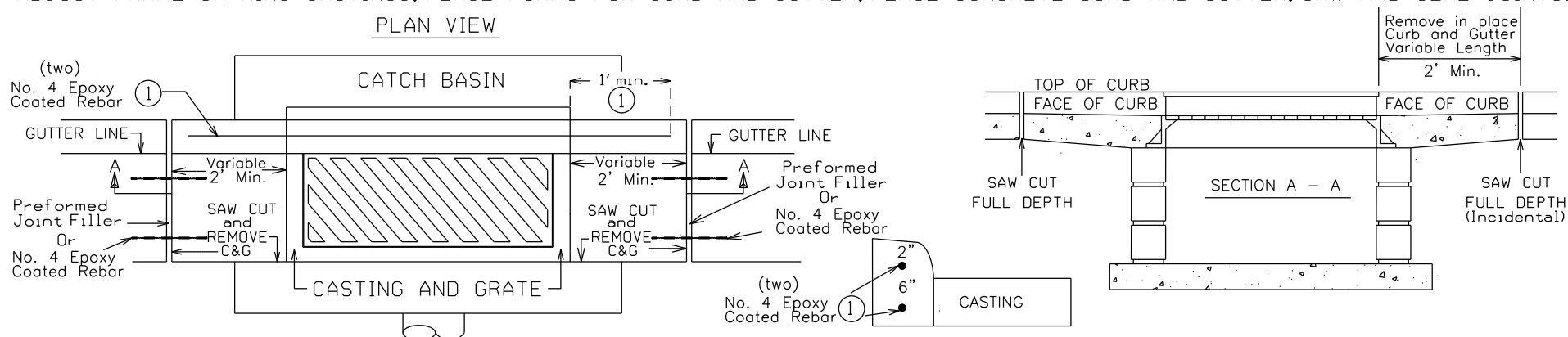
2302 Drill and Grout Reinforcement Bars (Epoxy Coated) (Each)

2531 Concrete Curb and Gutter, Design ----- (Lin. Ft.)

CATCH BASIN REPAIR

DESCRIPTION: SAW AND REMOVE IN PLACE CURB AND GUTTER, RESTORE AND COMPACT BASE, DRILL AND GROUT REINFORCEMENT BARS ADJUST FRAME OR RING CASTINGS, PLACE FORMS FOR CURB AND GUTTER, PLACE CONCRETE CURB AND GUTTER, SAW AND SEAL JOINTS.

PLAN VIEW



Notes

- * This detail is intended to fix sunken catch basins and the adjacent curb and gutter.
- * If the existing curb is integral with the concrete pavement, saw pavement full depth parallel to the curb face and at a offset distance equal to or greater than the width of the casting.
- * If concrete curb extends in back of the casting. Place two No. 4 epoxy coated rebars behind the casting. Extend reinforcement bars at least 1' foot beyond the limits of the casting. ①

WORK TO BE DONE

1. Define curb and gutter for removal. Remove any low spots that do not have positive flow into the catch basin.
2. Saw cut curb and gutter full depth. (Incidental)
3. Remove the in place curb and gutter. Do not damage the casting assembly during curb and gutter removals.
4. Salvage casting, remove deteriorated rings, add adjusting rings as needed, set casting, grout rings and casting.
5. When the existing pavement is concrete, drill and grout No. 4 reinforcement bars, 18" long, installed at 2' centers and placed 9" into existing concrete pavement.
6. Compact in place base and set forms for curb and gutter.
7. Furnish and place Concrete Mix Number 3F52.
8. Vibrate, finish to grade and slope, edge, texture, and apply cure.
9. Saw and seal longitudinal joints in accordance with Joint Repair (Type A1). (Incidental)

BASIS OF PAYMENT

2104	Remove Curb and Gutter (Lin. Foot)
2506	Adjust Frame or Ring Casting (Each)
2302	Drill and Grout Reinforcement Bars (Epoxy Coated) (Each)
2531	Concrete Curb and Gutter, Design _____ (Lin. Foot)

**2019 Construction Standard
City of Duluth, Minnesota
Public Works & Utilities
Engineering Division
April 5, 2019**