2024 STANDARD SPECIFICATIONS FOR CONSTRUCTION

CITY OF ROYAL OAK, MICHIGAN

Royal Oak
COMMUNITY
DEVELOPMENT

www.romi.gov

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October 30, 2024

TO ALL PROSPECTIVE BIDDERS

The 2024 Edition of the **"Standard Specifications for Construction"** is hereby issued by the City of Royal Oak, Michigan, in an effort to ensure the use of uniform, adequate, and acceptable construction methods and materials.

Copies may be obtained from the City website at: www.romi.gov/Engineering

These specifications have been formatted for double-sided printing.

These standards will be used for all work performed in City of Royal Oak Public Right of Way and Engineering Projects, for work and materials placed under Permit or Contract after October 30, 2024.

CITY OF ROYAL OAK

Holly J. Donoghue, P.E.
City Engineer

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City of Royal Oak

Addresses / Phone Numbers

Addresses

Royal Oak City Hall
203 S. Troy Street
Royal Oak, Michigan 48067

Royal Oak Department of Public Service
1600 N. Campbell Road
Royal Oak, Michigan 48067

Southeastern Oakland County Water Authority
3910 W. Webster Road
Royal Oak, Michigan 48073

Phone Numbers

Royal Oak Police Main Desk 248.246.3500

Royal Oak Fire Main Desk..... 248.246.3800

Royal Oak Engineering Division 248.246.3260

Royal Oak Department of Public Services..... 248.246.3300

Southeastern Oakland County Water Authority 248.288.5150

MISS DIG (underground utility staking) 1.800.482.7171
or 811

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STANDARD INSTRUCTIONS TO BIDDERS

1. **GENERAL PURPOSE AND INTENT**: These "Standard Instructions to Bidders" contain information and requirements pertinent to the proposed work. Such instructions and requirements apply to this Contract except as may be modified and supplemented by specific requirements contained elsewhere in these Contract Documents.

In addition to these instructions, the project-specific "Advertisement" and "Special Instructions to Bidders" contain information for bidders. Bidders must familiarize themselves with all provisions of the Contract Documents and their effect.

2. **THE CONTRACT DOCUMENTS**: The Contract Documents consist of the material outlined in Paragraph 1.01 of the "General Conditions".

In addition to the above, any and all addenda become a part of the Contract Documents. In the process of assembling and binding the Contract Documents, individual pages or drawings may have been inadvertently omitted. Each bidder shall carefully examine his copy of the Contract Documents for completeness. No claim of any bidder will be allowed on the basis that his copy of the Contract Documents was incomplete.

Titles, sub-titles, headings, running headings and tables of content as used throughout the Contract Documents are merely for convenience and in themselves are not a contract provision or requirement and are not to be taken into account in any way in construing any of the rights or obligations of the parties to the Contract.

3. **INTERPRETATION OF CONTRACT DOCUMENTS**: Should any prospective bidder be in doubt as to the true meaning of any portion of the Contract Documents, or should he find any patent ambiguity, inconsistency, or omission thereon, he shall request the Engineer, in writing, for an official written interpretation or correction. The person making the request will be held responsible for its prompt delivery.

Such interpretation or correction will be made only as an addendum which will be mailed or delivered to each person recorded as having received a copy of the Contract Documents.

Only the Addenda duly issued by the Engineer shall be binding. Prospective bidders are cautioned that oral interpretation, information, or instructions by any officer or employee of the Owner or Engineer is not authorized.

4. **BIDDER'S EXAMINATIONS AND INVESTIGATIONS**: The prospective bidder shall carefully and thoroughly examine all parts of the Contract Documents with maps, drawings, and other data mentioned therein as being on file in the Owner's or Engineer's office for examination.

The bidder shall make an inspection of the site of the proposed work as well as its adjacent area, and determine for himself all conditions under which he will be obligated to work.

No plea of ignorance of conditions that may exist or that may hereafter exist, or of difficulties that may be encountered in the execution of the work under this Contract, as a result of the bidder's failure to make prudent examinations and investigations, will be

accepted as an excuse for any failure or omission on the part of the Contractor to fulfill in every detail all requirements of the Contract Documents, nor will same be accepted as a basis for a claim for extra compensation, damages, or for an extension of the time of completion.

5. **LABOR AND MATERIAL**: The bidder shall make his own investigation as to the availability of labor needed and the wage rates which will have to be paid in the prosecution of the Contract. No claim for extra cost or damages shall be made or allowed because of shortages of the required labor or any change in the wage rates which the Contractor is required to pay.

The bidder shall make his own investigation and determination of the probable availability of the required materials in the amounts and at the times necessary to complete the work within the time allowed for completion.

6. **BIDDER'S QUALIFICATIONS**: Bids are solicited only from responsible bidders known to be skilled and regularly engaged in work of similar character and magnitude to that covered by the Contract Documents.

7. **BIDDER'S REQUIREMENTS**: The following requirements **shall** be provided with the bid, unless otherwise required in the Special Instructions to Bidders portion of the Contract Documents:

A. Address and description of bidder's place of business.

B. Five references of similar jobs. The references shall include a one sentence job description, the year of work, and the owner's representative name, title and phone number.

The successful low bidder will be required to provide documentation of having performed this type, quantity item / volume or dollar amount of work for a public agency (village, city, or county) in the past two (2) years.

C. A detailed Construction Schedule showing all major items of work including 24 hour emergency call out numbers. The Construction Schedule shall include staffing to be used by the Contractor in the execution of the Contract and shall include, but not be limited to, the following:
   1. Start and End date for the work
   2. Intermediate milestone dates required by Contract
   3. Sequence of work with specific geographic locations
   4. Crews to be assigned to the work
   5. Number of men in each crew
   6. Contractor shall indicate crews on construction schedule

D. Equipment to be on site and used on the project.

E. Itemized list of equipment available for use on the project.

F. List of contracts on which the bidder is currently engaged.

G. List of names of proposed subcontractors to be used on the project.

H. Such additional information as will satisfy the owner that the bidder is adequately prepared, in technical experience and otherwise, to fulfill the Contract.

8. **JOINT BIDDING**: A bid submitted by two or more parties will be considered as a joint bid. When bidding jointly, each party will be jointly and severally responsible for the total amount of the bid and the costs. The bidders shall state their bid is a joint bid and list all parties involved.

9. **FORM OF PROPOSAL**: All proposals are to be made upon the Form of Proposal provided with bid documents, of which additional copies may be obtained at the office of the City Engineer. Proposals must be made in full conformity to all the conditions as set forth in the bid documents.

10. **PREPARATION OF PROPOSALS**: Proposals must be carefully prepared in strict accordance with these instructions; otherwise, the bid may be rejected and not considered in the award of the Contract. Negligence on the part of the bidder in preparing the bid confers no right for the withdrawal of the bid after it has been opened.

The Form of Proposal (FOP) supplied shall be used and shall be submitted intact as originally bound. No changes shall be made in the working of the form or in any of the items mentioned therein. Proposals shall be filled out legibly in ink. Erasures or other changes in the bid shall be explained or noted over the signature of the bidder. Failure of the bidder to submit the required information or the submission of information in an incomplete form **may be cause for rejection of the entire proposal**.

Any stipulation or qualification contrary to the Contract requirements made by the bidder in his FOP as a condition for the acceptance of the Contract will not be considered in the award of the Contract and may cause the rejection of the entire Proposal.

When the FOP provides for evaluated bids, full information shall be supplied and computations shall be made by the bidder in accordance with the manner and method provided for in the Proposal. On unit price proposals, quantities shown shall be extended at the unit price given by bidder to verify the total cost of item.

If the bid is signed by an individual acting as an agent for the principal in whose name the FOP is submitted, in addition to the above applicable requirements, there shall be attached to the proposal a power-of-attorney evidencing authority of the individual to sign and submit the bid in the name of the designated principal.

11. **SUBMITTING PROPOSAL**: The Form of Proposal shall be submitted in the bound documents together with the required bid deposit. These documents shall be securely sealed in the envelope furnished, labeled with the title of the project as shown on the cover sheet of these Contract Documents, the date and time of bid opening and the bidder's name and address. Bids may be submitted electronically if specifically approved in the contract documents.

Bids will be received until the time stated in the "Advertisement" or until the time as extended by Addenda. Bids may be delivered in person or mailed, but delivery is the bidder's entire responsibility. Any bid received after the stated hour, even through the mail, will be returned unopened to the bidder.

Bids received prior to the scheduled time for receipt of bids will be kept securely, unopened. Bidder may not withdraw his bid after the hour of opening.

12. **PRICES BID**: The prices shall cover costs of any nature, incident to and growing out of the work, in explanation, but not in limitation thereof the prices stated in the proposal by the bidder, shall include the cost of everything necessary for the performance and completion of this Contract in the manner and time prescribed, including the furnishing of all materials, tools, equipment, transportation, labor, supervision, all costs on account of loss by damage or destruction of the work and unforeseen difficulties encountered, for settlement of damages, for replacement of defective work and materials, and for all else necessary therefore and incidental thereto.

All items of work in the Contract will be measured and paid at the units and prices shown on the Form of Proposal (FOP). The miscellaneous items not shown on the FOP such as clean-up, etc. will be considered as included as part of the Contract and done at no extra cost to the City.

13. **LEGAL STATUS OF BIDDERS**: The legal status of the bidder, whether corporation, partnership, or individual, shall be stated in the Proposal. A corporation bidder shall give the state in which incorporated; a partnership bidder shall give the full names of all the partners. Partnership and individual bidders will be required to state in the Proposal the names of all persons interested therein.

14. **ADDRESS OF THE BIDDER**: The place of residence of each bidder, or the office address in the case of a firm or company, with county and state, must be given after his signature.

15. **AGENCY**: Anyone signing a proposal as an agent of another or others must submit with his proposal evidence of his legal authority to do so.

16. **BID DEPOSITS**: Each Proposal shall be accompanied by a certified check or a Bid Bond by a recognized surety company, similar to a U.S. Government Standard Form Bid, in the amount of five percent (5%) of the amount of the bid, payable to the City of Royal Oak, Michigan, to be forfeited to said City in case of failure on the part of the successful bidder to enter into the attached form of agreement to do the work covered by such proposal at the price and within the time stated therein. The bid deposit of the three lowest acceptable bidders will be returned within 48 hours after the executed Contract has been finally approved by the City. The bid deposit of the other bidders shall be returned within 48 hours after the bids are opened.

17. **AWARD OF CONTRACT**: The Contract will be awarded to the lowest responsible bidder complying with the requirements of the Contract Documents. Provided his bid is reasonable and the best interest of the subdivided among two or more bidders on designated parts of the work listed in the Form of Proposal (FOP) when the total of the lowest responsible bid for the individual parts is less than the lowest responsible bids for the entire work. A Contractor shall bid on all items/parts listed in the FOP.

The Contract with the City will be awarded after the formal approval of the governing body, and written notice issued by the City to the intended awardee. The Contract will not, however, be valid or binding upon the City until the “Agreement” has been duly executed by both parties, the surety bonds and evidence of insurance furnished and the

executed Contract Documents have been endorsed and confirmed in accordance with the specific City Charter and/or Ordinance.

18. **EXECUTION OF THE CONTRACT**: The bidder to whom the Contract is awarded will be required to execute the Contract and to furnish Certificates of Insurance and Bonds as hereinafter specified, within ten (10) days (Sunday and legal holidays excluded) after the award and, in the case of his refusal or failure to do so, he may be considered by the City to have abandoned his right and interest in the Contract, and his certified check or Bid Bond may be declared to be forfeited to the City, and the Contract may be awarded to another.

19. **BONDS**: The successful bidder will be required to execute the bonds, on the forms included in this section, with surety companies that are duly licensed or authorized in the State of Michigan to issue bonds for the limits and coverages required. One bond is to be executed to the city and to be conditioned for the faithful performance and fulfillment of the Contract work for a period of one (1) year after the date of the final Contract payment estimate. The other bond is to be executed to the People of the State of Michigan and to be conditioned for the payment of all labor and materials used in the work and the protection of the city from all liens and damages arising therefrom; each of which bonds shall be based on 125% of the total amount of the Contract as calculated at the time the bids are received.

Standard forms for the Performance, Maintenance and Guarantee Bond and the Labor and Material Bond are provided on the following pages.

PERFORMANCE, MAINTENANCE AND GUARANTEE BOND

KNOW ALL MEN BY THESE PRESENTS, THAT WE _____,
Contractor, as Principal, and _____ as surety, are held and firmly bound unto the City of Royal Oak, Michigan (hereinafter called the CITY) in the sum of:_____ Dollars ($_____) to be paid to the CITY for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally to those presents.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT,

WHEREAS, the above named Principal did on the _____ day of _____, 20_____ by articles that date, enter into a Contract with the CITY for the _____.

NOW THEREFORE, if the said Principal shall save and hold harmless the said CITY from all public liability and damages of every description in connection therewith, shall well and faithfully in all things fulfill the said Contract according to all the conditions and stipulations therein contained, in all respects, and shall save and hold harmless the said CITY from and against all liens and claims of every description in connection therewith and for a period of one year after the completion of the work upon certification of the Engineer shall replace all work performed and materials furnished that are not performed or furnished according to the requirements of the Contract and make good all defects thereof which shall become apparent before the expiration of said period of one year, then the obligation shall be void and of no effect, but otherwise it shall remain in full force and virtue, and in the event that the said CITY shall extend the time for the completion of said work or otherwise modify elements of the Contract in accordance with the provisions thereof, such extension of time or modification of the Contract shall not in any way release sureties on this bond.

NOW THEREFORE, the Principal guarantees that for a period of one (1) year from the date of the final estimate he will, without cost to the CITY, keep in good order and repair any defect in the work done under said Contract by his employees, agents, subcontractors, or material suppliers, that may develop during said time due to improper materials, defective equipment, workmanship or arrangements, and that he will likewise restore to good condition any work disturbed while correcting such defects, excepting only such part or parts of said work which may have been disturbed without his consent or approval after acceptance thereof by the CITY: and that whenever directed to do so by the CITY, through written notice served personally or by mail upon the Principal at

_____ or upon the Surety (Sureties) at _____, he will proceed at once to make the repairs specified, and in case of failure to do so, within one week from the date of service of said notice or such additional time as may be fixed therein the CITY shall have the right to purchase such materials and employ such labor and equipment as may be necessary to undertake, do and make such repairs, and to be reimbursed by the Principal or Surety (Sureties) for the full expense thereof. If it is necessary to make any repair or set a barricade at once to protect life and property, the CITY may take such action immediately without notice to the Principal or Surety (Sureties). The CITY shall not be obligated to obtain the lowest bids for doing the work, or any part thereof, but all sums actually paid therefor shall be reimbursed by either the Principal or Surety (Sureties). In this connection, the judgment of the CITY shall be final and conclusive. If the Principal, for a period of one (1) year from the date of the final estimate, shall keep the work done under the aforesaid Contract in good order and repair, excepting only such part or parts of said work which may have been disturbed without his consent or approval after acceptance thereof by the CITY, and shall, whenever given notice as herein provided, immediately proceed to make specified repairs, or, in default thereof shall reimburse the CITY for expenses incurred in making such repairs, and shall fully indemnify, defend and save the CITY harmless from all suits and actions for damages of every name and description brought or claimed against it, for or on account of any injury or damage to person or property received or sustained by any party or parties, by or from any of the acts or omission or through the negligence of the Principal's employees, agents, subcontractors or material suppliers in the performance of the work required by said Contract, and from any and all claims arising under the Workers' Compensation Act of the State of Michigan, as amended, then the above obligation shall be void, otherwise to remain in full force and effect.

IN WITNESS THEREOF, the parties herein have caused this instrument to be executed by their respective officers this _____ day of _____, 20_____.

Signed, Sealed and Delivered
in the presence of:

_____ _____(Seal)

_____ _____(Seal)
Principal

BOND CORRECT AS TO FORM:

_____ _____(Seal)
City Attorney

Performance Bond
(Maintenance Stipulation)

LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS, that we _____, Contractor, as Principal, and , as Surety, are held and firmly bound unto the City of Royal Oak, Michigan (hereinafter called the CITY) in the sum of _____ Dollars ($_____) to the payment whereof, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally to these presents.

THE CONDITION OF THIS OBLIGATION is such that:

WHEREAS, the above named Principal did on the _____ day of _____, 20_____, by articles that date, enter into a Contract with the CITY for the _____.

AND WHEREAS, this bond is given in compliance with and subject to the provisions of Act No. 187 of the Public Acts of Michigan (1905) as amended, the same being sections 570.101 to 570.105 inclusive, of the Compiled Laws of the State of Michigan for 1948 and P.A. 213 (1963), as amended.

NOW THEREFORE, if the above named principal, legal representatives, or successors shall pay or cause to be paid to all subcontractors, persons, firms and corporations as the same may become due and payable, all indebtedness which may arise from said principal to a subcontractor, to any person, firm or corporation on account of any labor performed or materials furnished in connection with the Contract, construction and work herein referred to, then this obligation shall be void; otherwise to remain in full force and effect.

This bond is given upon the express condition that any changes, alterations, or modifications that may be hereafter recorded or made in the construction and complete installation of the work herein referred to, or the placing of an inspector or superintendent thereon by the CITY shall not operate to discharge or release the sureties thereon.

IN WITNESS THEREOF, the parties hereto have caused this instrument to be executed by their respective officers this _____ day of _____, 20____.

Signed, Sealed and Delivered
in the presence of:

_____ _____(Seal)

_____ _____(Seal)
Principal

BOND CORRECT AS TO FORM:

_____ _____(Seal)
City Attorney

Labor and Material Bond

20. **RIGHT TO REJECT AND TO WAIVE DEFECTS**: The City reserves the right to reject any or all Proposals, and to waive any defects or irregularity in any Proposal if it appears to be in the best interest of the City to do so.

21. **WITHDRAWING PROPOSAL**: A Proposal after being submitted may be withdrawn when request therefore is made in writing by the bidder before the time designated in the Advertisement for the opening of the Proposals.

22. **CONSTRUCTION SCHEDULE**: The Construction Schedule submitted by the Contractor is subject to the approval of the Engineer. The Engineer may revise the Construction Schedule when he determines it is in the best interest of the City. Construction Schedule changes are incidental to the Contract and shall be made at no increased cost to the City.

23. **SUNDAY AND HOLIDAY WORK**: In general, no work shall be performed pursuant to this Contract on Sunday and holidays except work of an emergency nature that is necessary in order to safeguard life and property. Permission must be obtained in advance from the City Engineer for Sunday and holiday work. The Contractor shall notify the City Engineer in writing at least two days in advance concerning work that he plans to perform on Sunday and / or holidays.

24. **TAXES**: All Federal, State, and Local Taxes, when applicable, shall be included in the Proposal and shall be paid by the Contractor.

25. **MISS DIG NOTIFICATION**: It will be the responsibility of the Contractor to notify utility companies 72 hours prior to excavating, by calling Miss Dig at 1.800.482.7171 or 811. It is the Contractor's responsibility to protect and maintain MISS DIG markings or stakes once placed by the utility, and comply with Public Act 53, Public Acts of 1984 (Miss Dig Law), and any amendments to that act.

26. **PROJECT AND CONSTRUCTION SIGNING & BARRICADING**: The Contractor shall provide all signing and barricading required to perform the work specified in this Contract and shall be removed immediately after work is complete. This work shall be done in accordance with **Public Act 315 of 2003 effective April 8, 2004**, the provisions of Sections 104.11 and 812 of the current **MDOT Standard Specifications for Construction**, and signing shall conform to the current edition of the **Michigan Manual of Uniform Traffic Control Devices** (MMUTCD) except as otherwise specified herein.

In addition to working only one side of the street, the Contractor shall perform his work in such a manner so as to keep the street open to traffic. The Contractor shall utilize a sufficient number of traffic regulators to maintain one lane of traffic in each direction as a minimum traffic requirement on major roads. The traffic regulator material shall be maintained during and after working hours or until, in the judgment of the Engineer, the roadway is ready to be opened to traffic. Traffic regulator material shall consist of traffic cones, Type II and Type III Lighted Barricades. Arrow panels may be required with required lane tapers per MMUTCD. Traffic regulating personnel (flagger) will be required, when their use is directed by the Engineer. All traffic control shall be in compliance with the MMUTCD and as directed by the Engineer. "Road Work Ahead" signs (W20-1) shall be posted on streets and all abutting streets affected by construction. "Fresh Tar" signs (W21-2) shall be posted prior to prime coating all roads.

The addition of "Road Closed to Thru Traffic" (R11-4) signs placed along the construction zone may be required. Additional signs may be required as directed by the Engineer once the project begins. "Road Closed" and "Road Closed to Thru Traffic" signs shall be placed on Type III barricades at side street locations as directed by the Engineer. All traffic control work not specifically covered as a pay item shall be considered as part of the Contract. Construction signing and barricading shall be included as part of the Contract unless bid as a separate contract item to the Contract and shall be provided and maintained at no increased cost to the City.

27. **SWEEPING TO BE DONE BY THE CONTRACTOR**: The Contractor shall be required to wash and sweep all streets that he has paved, excavated or disturbed, as well as those over which he has hauled excavated material. The Contractor shall not rely upon hiring the City to do it for him. The Contractor shall water street pavement with a truck, tank or hoses from approved fire hydrants, then sweep with a mechanical pick-up type street cleaner approved by the Engineer. This material shall be hauled to an approved dump site. Paved surfaces shall be swept daily or as directed by the Engineer. This sweeping shall be included (unless bid as a separate item) as part of the Contract and shall be performed at no increased cost to the City.

28. **STAKES AND MARKS**: Unless shown in Contract Documents, the Contractor shall furnish substantial stakes and marks conveniently placed showing the location and elevation of the various parts of the work. No work shall be undertaken until such marks and stakes have been set by the Contractor. The Contractor shall take due and proper precautions for the preservation of these marks and stakes and shall see to it that the work at all time proceeds in accordance therewith.

If it shall become necessary to replace any mark or stake due to failure of the Contractor to take proper precautions for its preservation, or because of carelessness upon the part of his employees, or those of his subcontractor, or suppliers of materials the Contractor will replace the mark or stake with no increased cost to the City.

29. **MEASUREMENTS**: Due and proper measurements shall be taken by the Engineer during the progress of the work, or any part thereof, either before or after commencement of construction. If such alterations diminish the quantity of the work to be done, they shall not warrant any claim for damages of or for anticipated profits on the work to be dispensed with; if such alterations increase the amount of the work to be done, such increase shall be paid for according to actual quantity done at the contract unit price stipulated for such work on the Proposal.

The City reserves the right to increase or decrease any quantity given in the Contract which the City determines is in its best interest during the construction of the project with no change in the contract unit price for the work.

30. **NOTICE OF INSPECTION**: The Contractor shall give the Engineer written notice forty-eight (48) hours (minimum) in advance of the manufacture and delivery of materials and beginning of construction for the purpose of proper and timely inspection. Materials may be inspected at the point of manufacture, or upon delivery as the Engineer may decide.

31. **PUBLIC SAFETY AND CONVENIENCE**: Protection of life and property are of the first importance and shall be provided for by the Contractor in an adequate and satisfactory manner. The Contractor shall also conduct his work with the least possible obstruction

or inconvenience to pedestrian, vehicular and other traffic as well as to utilities, business enterprise, the general public and the residents and property owners affected by the work being done under this Contract. The Contractor shall properly barricade any materials, equipment, debris and obstructions.

32. **PROTECTION OF EXISTING SURFACE AND UNDERGROUND STRUCTURES**: The Contractor shall protect, secure and support existing pavements, driveways, sidewalks, curbs, poles, foundations, sewers, drains, gas mains, water mains, house services and any other surface or underground structures so as to avert their being damaged through his operations, and he shall repair or replace any damage caused through his operations so that at the completion of the work, the condition of existing surface and underground structures shall be as safe and permanent as before the Contractor commenced his work. The Contractor shall indemnify, defend and save harmless the City and the Owner of the surface or underground structures against all damages or alleged damage to any such structures damaged as a result of his work. The Contractor shall not start with his work until he has made diligent inquiry at the proper offices of the City, the Utility Companies, Owners and other authorities to determine the location of any underground structures. Although the City will assist in locating underground structures as far as its records are concerned, the Contractor shall assume full responsibility as to determining the locations, it being understood that the information as given is the best available at the time.

If it shall become necessary to remove or change the location or grade of any pipes, structures or utilities, by reason of the construction of the work, the Contractor shall, in writing, notify the Engineer, the Utility Companies and other authorities, which may be affected, at least 72 hours previous to commencing the work at the point or points affected; or on failing to do so, any damage or injury which may result shall be repaired immediately by the City or the owners of such structures or utilities, and the cost thereof charged against the Contractor.

The Contractor shall maintain in continuous and effective service all sewer, drains and water courses touched during the progress of the work. If it shall become necessary, temporarily, to divert or obstruct the flow of any such sewer, drain or water course, written consent must first be obtained from the Engineer and the Contractor shall assume full responsibility for the consequences. Any sewer, drain, or water course disturbed during construction shall be restored to its original condition at the expense of the Contractor.

33. **STORAGE OF MATERIAL, ETC.**: Materials, tools and equipment shall not be distributed upon or near the site of the work in such manner as to obstruct traffic or cause unnecessary inconvenience. All materials and equipment shall be properly barricaded. The Contractor shall be held responsible for all materials until they are finally incorporated into the work and accepted. He shall be held responsible for and make good any damage done by reason of the storage of tools, materials and equipment. The Contractor shall not rely on the City to provide storage area(s) for equipment and materials.

34. **CARE OF HYDRANTS**: The Contractor shall be held responsible for the care of hydrants used during the scope of work and shall see that they are properly opened and closed. Hydrant wrenches shall be provided by the Contractor and shall be used to open and close hydrants. Hydrants shall be opened and closed slowly to prevent

disturbance in the system. The Contractor shall furnish and utilize a certified backflow preventer whenever accessing a hydrant. **The Contractor shall, after use of a Hydrant, pump out the Hydrant during the period October through May**. Whenever possible, a space of ten feet in the clear shall be maintained around fire hydrants and all materials accumulated during the progress of the work shall be promptly removed.

The Contractor shall first obtain permission from the Water Department before opening or operating any fire hydrant, and shall pay for any charges for the privilege or for the use of water, or for any damage he has caused to the hydrant.

When paving or other construction work requires the use of water, the Contractor shall be required to furnish all pipe and fittings and make all connections under the supervision of and in accordance with the requirements of the Water Department. Specific fire hydrants approved by the Engineer will be designated as water sources for the Contractor. The Contractor **shall not** request or use private water from private property owners.

35. **PROTECTION AGAINST ACCIDENTS**: The Contractor shall provide Traffic Regulating Personnel (flagger), and shall put up and maintain such barriers, barricades and required lighting and take such other precautions as may be necessary as a consequence of his work, to protect life and property, prevent accidents and injury and he shall be liable for all damage occasioned in any way by his acts or his neglect, or by the acts of his agents, employees or workers.

The Contractor, where directed shall erect directionally, detour and closure signs to direct vehicular and pedestrian traffic. All traffic control shall meet the current requirements of the "Michigan Manual of Uniform Traffic Control Devices".

36. **PROTECTION OF TREES, SHRUBS AND PLANTED GROWTH**: Where the work is to be performed adjacent to trees, shrubs or planted growth, ample precautions must be taken to protect the trees, shrubs and planted growth form injury by workers, equipment, or any other cause. Where necessary, in the opinion of the Engineer, trees, shrubs and planted growth shall be fenced in before construction starts, properly cared for, and replaced by the Contractor after his construction is completed. The protection shall be considered in the contract pay items. The Contractor shall replace any damaged trees, shrubs or plant material.

37. **PERMITS, CERTIFICATES AND LICENSES**: Unless otherwise noted in the Contract, the Contractor shall obtain all permits, certificates and temporary licenses necessary at his own expense, and shall conduct his work in full conformity with such permits, certificates and temporary licenses. The Contractor shall bear the cost of shutting or closing off and turning on all services of any nature which may be required by his operations. He shall furnish the City, at his own expense, with all necessary inspection certificates.

38. **UTILITIES**: The Contractor shall make arrangements for and shall pay for all connections, extensions and services for electricity, gas, water, sewer and other utilities necessary for the prosecution of the work.

39. **MATERIAL CERTIFICATIONS**: All materials supplied by the Contractor shall be certified in writing by the manufacturer showing that the materials supplied meet the

specification of the Contract. Their certification shall include the specification of the material supplied. No work may be done on the project with materials supplied by the Contractor without a written material certification approved by the Engineer.

40. **TESTS AND SAMPLING**: When specified that materials are to be tested they shall be tested at the expense of the Contractor, unless otherwise indicated in the specifications. The Contractor shall provide the necessary facilities for taking samples, shall furnish samples, and deliver them to the testing laboratories as the Engineer may direct. Samples shall be prepared for testing by the Contractor, if so required. Unless otherwise specifically provided, materials and products shall be sampled and tested in accordance with the requirements of the American Society for Testing Materials. The cost to the Contractor in connection with tests and sampling shall be included in the prices bid for the various items scheduled on the Proposal, and no extra allowance will be made.

41. **CONTRACTOR'S EMPLOYEES AND ORGANIZATION**: The Contractor shall employ competent workers, experienced enough to perform their work in a neat and proper manner. Superintendents, foremen, or other supervisory employees shall be competent and authorized to receive and carry out instructions at all times during the progress of the work.

Whenever the Engineer shall inform the Contractor in writing that any person engaged in the work is, in his opinion, disobedient, disorderly, disrespectful, incompetent or intemperate or that a superintendent, foreman or other supervisory personnel refuses, or neglects to comply with the order of the Engineer, they shall be promptly discharged and shall not thereafter be re-employed on the work. The superintendents and number of workers shall be sufficient, in the opinion of the Engineer, to insure completion of the work within the time limited.

When specified in the Contract, the Contractor shall establish and maintain a temporary office for use by the Engineer on the site of the work or provide other facilities at some convenient point thereto, during the continuance of the work. Copies of the plans and specifications shall at all times be kept on file by the Contractor at readily accessible points near the work. The temporary office shall be incidental to the Contract.

42. **PARTIAL USE IN THE WORK**: The City shall have the right to use and place in use, any of the work as soon as the same is available, and such use shall not be considered as an acceptance of the work or any part thereof, nor shall it affect the maintenance period, where such period is called for.

The City may allow work by other Contractors, by City forces and/or public utility companies during the progress and within the limits of or adjacent to the work included in this Contract. Cooperation with such other parties will be expected by the City so as to cause as little interference as possible with such other work as the Engineer may direct.

The Contractor shall agree and hereby does agree to make no claims against the City for additional payment due to delays or other conditions created by the operations of such other parties. If there is a difference of opinion as to the respective rights of the Contractor and others doing work within the limits of or adjacent to the work being done under this Contract, the Engineer will decide as to the respective rights of the various parties involved in order to secure the completion of the City's work in general harmony

and in a satisfactory manner, and his decisions shall be final and binding on the Contractor.

43. **TIME AND SEQUENCE OF WORK**: The order and sequence of the work to be done under this Contract shall be under the general direction of the Engineer who may make such reasonable requirements as may, in his judgment be necessary for the protection of work partially or wholly completed; and to these requirements the Contractor shall strictly conform.

44. **CLEANING UP**: Upon the completion of the work each day, the Contractor shall clean up and leave in neat condition all the premises that he has occupied during the construction period. The Contractor shall remove from his work area all debris and rubbish, and all unused materials when directed to do so by the Engineer. The Contractor shall remove all equipment, tools, and ground restoration shall be complete before the final estimate is processed.

45. **CUTTING EXISTING PAVEMENT**: Existing pavement, sidewalks, curbs, driveways, gutters, crosswalks and other bituminous or concrete surfaces to be removed shall be removed to the limits shown or as required by the Engineer. Removal work shall be carefully done and to a neat line. Concrete saws or other mechanical equipment approved by the Engineer shall be used in this work.

46. **NOTIFICATION TO FIRE DEPARTMENT**: The Contractor shall notify the Fire Department of the City of Royal Oak (phone 248.246.3800) whenever his construction work shall in any way interfere with the use of a street by fire vehicles. In case of doubt, the City may, in the interests of public safety, notify the Fire Department but such notification shall in no way relieve the Contractor of his responsibility.

47. **PRESERVATION OF MONUMENTS OR TITLE CORNERS**: When monuments, permanent title markers, or street corners are encountered, the Contractor shall not disturb them without the approval of the Engineer. He shall take every care to preserve their locations. If directed by the Engineer, he shall raise or lower them, or enclose them in standard monument castings. When they occur within the sidewalk and pavement area, they shall be relocated or enclosed in monument boxes as a part of the sidewalk and pavement construction, and no extra allowance will be made. For others outside the sidewalk and pavement area, they shall be paid for as extra work. Monuments, permanent title markers or street corners moved without permission of the Engineer shall be relocated or replaced at the expense of the Contractor.

48. **EMERGENCY CALLS**: The Contractor shall provide a 24-hour emergency telephone number with the Construction Schedule. In the event the Contractor is contacted by the City of Royal Oak Police Department or the Engineer to respond to emergency situations, the Contractor shall respond immediately or the City of Royal Oak will proceed with the necessary emergency response and take all action the City deems necessary. The Contractor shall reimburse the City of Royal Oak for all expenses incurred for the emergency response upon receipt of billing.

49. **COMPLAINTS**: The Engineer will investigate all complaints received from property owners regarding work done by the Contractor and / or its subcontractors, and shall also have the right to make investigations on his own initiative. If, in the opinion of the Engineer, any work has not been done in accordance with this Contract and

specifications, he shall immediately so notify the Contractor, informing him of the nature of the defect, location, remedies, desires and a time limit within which the defect may be remedied. Should the Contractor fail to remedy the defect within the time limit allowed, the Engineer may do so with City forces and deduct the cost thereof from the amount due the Contractor at the time of final estimate; or the Engineer may, in the alternative notify the Contractor to stop all other work under this Contract until the defect has been remedied. The City shall not be required to pay for any work done by the Contractor in violation of any such stop order, and the amount due for any such work shall be regarded as liquidated damages due the City as a result of such breach of this Contract.

50. **CLEANING OF DRAINAGE STRUCTURES**: Manholes, catch basins and other underground structures lying within the limits of the construction shall be kept free of dirt, debris, concrete and all other materials which might cause stoppage or other damages to sewer lines. Contractor shall inspect and clean such structures immediately after the excavation work and again as soon as the surrounding work is substantially complete. In the event that sewer troubles develop, they shall be investigated and repaired by the City. If the investigation reveals that the trouble has been caused by carelessness or failure to take proper precautions for the protection of the sewers and drainage structures on the part of the Contractor and / or subcontractors, their employees, or equipment, the City may deduct the cost of the repairs from the amount due the Contractor at the time of the final estimate.

51. **RESPONSIBILITIES OF CONTRACTOR FOR DAMAGES TO WORK**: The Contractor shall be responsible for any and all damages that the work may sustain prior to its final acceptance. He shall, at his own expense, and as directed by the Engineer, rebuild, repair, restore and make good all injuries and damages to any portion of the work by the action of the elements or from any cause whatsoever including mechanical, human or animal that it may sustain prior to its final acceptance.

52. **PUBLIC UTILITIES**: The Contractor shall check the location and status of all existing utilities within the limits of this project with the Owners before construction is started as a precaution against damaging them in consequence of any act or omission on his part or on the part of his employer or agents. No additional compensation will be paid to the Contractor for any delays, damages, repairs, or other expenses due to existing utilities within the project limits.

Owners of public utilities will not be required to move additional poles and structures in order to facilitate the operation of construction equipment unless it is determined by the Engineer that such pole lines or structures constitute a hazard to the public or are extraordinarily dangerous to the construction operation.

53. **CONTRACTOR'S RESPONSIBILITY FOR UTILITY WORK COORDINATION**: The Contractor shall coordinate his work so as not to delay or interfere with other contractors, utility companies and City of Royal Oak forces working in the right-of-way. The Contractor shall make every effort to cooperate with other contractors, utility companies and City of Royal Oak forces working in the immediate area. No compensation whatsoever shall be sought from the City of Royal Oak because of delays due to coordinating with other contractors, utility companies or City of Royal Oak forces working in the right-of-way.

54. **HAUL ROUTES**: The Contractor shall secure permission from the authorities having jurisdiction, for the use of a particular road as a haul route. Loading restrictions shall be observed.

Trucks hauling excavated materials, cement, sand, stone or other loose materials from or to site, shall be tight so that no spillage will occur on adjacent streets (or Haul Routes). Before trucks start away from the site, their loads shall be carefully trimmed, by hand, and covered if necessary.

55. **DRIVEWAYS**: Driveway approaches that are removed shall be temporarily replaced the same day with material approved by the Engineer, as provided for in the Contract, and shall be maintained thereafter.

56. **TREE BORING**: This item of work shall be done as called for on the Construction Plans or as directed by the Field Engineer. All trees eight (8) inches in diameter or less shall require a boring of eight (8) feet long. Trees over eight (8) inches in diameter, measured four (4) feet above the ground surface, shall require a boring of the length of one (1) foot for each inch of tree diameter.

This work shall be done with an approved boring machine. The boring will be done with or without a sleeve, depending on the type of soils, and the diameter of the auger shall not exceed four (4) inches over the outside diameter of the pipe to be installed. The approval of any type of tunneling other than with an approved boring machine shall be denied. The cavity between the outside of the pipe and undisturbed ground shall be sealed at both ends of the bore with 2500 p.s.i. concrete a minimum of eight (8) inches thick.

57. **CONTRACTOR RESIDENT NOTIFICATION AND SIGNING**: The Contractor is responsible for written notification to residents and businesses in construction areas with notices approved by the Engineer.

For construction operation(s) that will require closure of a portion of a road for more than 24 hours, the Contractor or Permittee shall provide written notice of the closure to the occupants of all properties immediately adjacent to the portion of the road that is to be closed at least seven (7) calendar days prior to commencing operation(s). Prior to commencing any operation(s), the Contractor or Permittee shall provide the Engineering Department with written confirmation that notice has been provided consistent with this policy.

Signing construction areas for no parking is the Contractor's responsibility. The "No Parking Tow Away Zone" signs will be supplied by the City, however, sign stakes or holders are the responsibility of the Contractor. Trees CANNOT be used as sign posts. Signs must be placed no more than 100 feet apart and no further than 3 feet from the back of curb in construction areas. Signs shall be posted 12 hours before construction begins, and shall be removed within 24 hours following completion of the work.

58. **WINTER CONSTRUCTION**: The City shall have authority to oversee the prosecution of work which is contracted to be done during the winter months. The Contractor shall provide adequate weather protection, temporary heating and any other measures which are necessary to ensure that work performed during the winter months is properly installed and protected against damage from freezing.

Permanent pavement replacement shall be limited to the period of April 1st to November 15th or as approved by the Engineer. Any street crossing or driveway crossings made after November 15th shall be backfilled with sand compacted to 95% Standard Proctor Density and a temporary pavement installed of 3" of asphalt cold patch or temporary hot mix over 4" crushed concrete base. The Contractor is responsible for maintenance of the temporary pavement throughout the term of the project including the winter months. Snow removal shall be the responsibility of the City. When, in the opinion of the City, the temporary pavement requires repair, the Contractor will be notified. Once notified, the Contractor will have 24 hours to make the necessary repairs.

If the Contractor fails to make the repairs in the allotted time period and City forces are required to do the work, any costs incurred by the City will be deducted from the payment due the Contractor. Any costs involved in installing or maintaining the temporary pavement shall be considered incidental to the Contract.

59. **CONFINED SPACE ENTRY**: The Contractor must comply with M.I.O.S.H.A. requirements for required Confined Spaces as defined by Michigan Occupational Safety and Health Act (M.I.O.S.H.A.) Standard 1910.146, Part 90 inclusive. The City has determined that all utility structures and pipes under its jurisdiction are potentially permit-required confined spaces. Prior to commencing any underground work, the Contractor shall furnish the Engineer written certification that the company has implemented a Permit-Required Confined Space program conforming to M.I.O.S.H.A. requirements. Questions concerning the M.I.O.S.H.A. requirements should be directed to the Construction Safety and Health Division at 517.284.7680.

GENERAL CONDITIONS

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GENERAL CONDITIONS

1.00 DEFINITIONS

1.01 **CONTRACT DOCUMENTS**: shall mean the following documents, including all additions, deletions and modifications incorporated therein before the execution of the Contract:

Part I Contract Forms
- Advertisement
- Special Instructions to Bidders
- Standard Instructions to Bidders
- Form of Proposal
- Agreement
- Insurances
- Performance, Maintenance & Guarantee Bond
- Labor and Material Bond
- Contractor's Affidavit
- General Conditions

Part II Specifications
- Project Specifications
- Royal Oak Standard Specifications for Construction (current)

Part III Contract Drawings

1.02 **ACT OF GOD**: means an earthquake, flood, cyclone, or other cataclysmic phenomenon of nature. Rain, wind, flood, or other natural phenomenon of normal intensity for the locality shall not be construed as an Act of God.

1.03 **ADDENDA OR ADDENDUM**: shall mean any additional contract provisions or changes, revisions or clarification of the Contract Documents, issued in writing by the Engineer, on behalf of the City, to respective bidders prior to the receipt of bids.

1.04 **AUTHORIZATION**: The City's written approval of recommended contract changes, adjustments or extras to the Contract.

1.05 **AWARD**: The City's formal execution of the Contract.

1.06 **BIDDER**: shall mean any individual, firm or corporation submitting a formal Proposal for construction under this Contract.

1.07 **CONTRACT MODIFICATION**: shall mean a written notice authorizing or directing a Contractor to do Extra Work or to authorize deviation from the Plans and / or Specifications.

1.08 **CITY**: shall mean the party of the first part as shown on the Contract.

1.09 **CONTRACT**: is the agreement covering the performance of the work described in the Contract Documents and includes all supplemental agreements thereto.

1.10 **CONTRACT UNIT PRICE**: The unit price of a contract item.

1.11 **CONTRACTOR**: shall mean the party of the second part as shown on the Contract.

1.12 **ENGINEER**: shall mean the City Engineer of the City of Royal Oak, Michigan or his/her duly authorized agents, assistants, or representatives, limited to the specific duties assigned or entrusted to them.

1.13 **EXTENSION OF TIME**: Additional contract time authorized by the Engineer.

1.14 **EXTRA WORK**: Typically work issued by the Engineer through a Speed Letter or Contract Modification that was not originally included in the original Contract Documents.

1.15 **HOLIDAYS**: Recognized City holidays are: New Year's Day, Good Friday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and the Friday after, Christmas Eve, Christmas Day and New Year's Eve.

1.16 **IMPLIED or INCIDENTAL WORK**: shall mean any work, except Extra Work as hereinafter defined, which may have been omitted in the description of said work, but the need of which is implied or necessary and is included in the cost to perform the item of work.

1.17 **INSPECTOR**: The representative of the Engineer, assigned to make inspections of contract performance.

1.18 **PERFORMANCE BOND**: The security furnished by the Contractor and the Contractor's Surety to guarantee performance of the work in accordance with the Contract.

1.19 **PLANS**: shall mean drawings or reproductions of drawings prepared by the Engineer pertaining to the construction or details of the work included in the Contract.

1.20 **PLAN QUANTITY**: The original contract quantity of an item of work.

1.21 **PROGRESS SCHEDULE**: A sequential listing of all the controlling operations and the estimated time the operations will remain controlling. The Progress Schedule is submitted by the Contractor and approved by the Engineer prior to award of the Contract and becomes part of the Contract.

1.22 **PROJECT**: shall mean the entire improvement proposed by the City to be constructed, in part or in whole, pursuant to the Contract.

1.23 **PROPOSAL**: is the offer of a bidder to perform the work described by the Contract Documents when made out and submitted on the prescribed form of proposal, properly signed and guaranteed.

1.24 **RESIDENT ENGINEER and / or INSPECTOR**: shall mean a duly authorized representative of the Engineer.

1.25 **SPECIFICATIONS OR CONTRACT SPECIFICATIONS**: shall mean all of the Contract Documents and Supplemental Agreements.

1.26 **SUBCONTRACTOR**: shall mean a person, firm or corporation, other than the Contractor, supplying labor and material or labor to the Contractor for work at the side of the project, but shall not include one who furnished materials or equipment, only.

1.27 **SURETY**: The legal entity or individual other than the Contractor, executing a bond(s) furnished by the Contractor.

1.28 **TRAFFIC CONTROL DEVICES**: Signs, signals, lighting devices, barricades, delineators, pavement markings, traffic regulators and all other equipment for protecting and regulating traffic in accordance with the current edition of the M.M.U.T.C.D, unless otherwise specified in the Contract.

1.29 **THE WORK**: shall mean all structures, equipment, plant, labor, material, and facilities or things new or hereafter required to be furnished, installed or done by the Contractor under or pursuant to this Contract including Extra Work.

1.30 **WORK**: shall mean any component structure, equipment, plant, labor, material or facility of The Work.

1.31 **WRITTEN NOTICE**: shall be considered served when delivered in person or sent by U.S. mail to the last business address known to him who serves this notice. It shall be the duty of each party to advise the other party to the Contract as to any change in his business address until completion of the Contract.

1.32 **A.S.T.M.** American Society for Testing Materials

1.33 **A.W.W.A.** American Water Works Association

1.34 **A.S.A.** American Standard Association

1.35 **A.C.I.** American Concrete Institute

1.36 **C.R.S.I.** Concrete Reinforcing Steel Institute

1.37 **MDOT** Michigan Department of Transportation

1.38 **N.E.C.** National Electric Code

1.39 **A.A.S.H.T.O.** American Association of State Highway and Transportation Officials

1.40 **M.D.P.H.** Michigan Department of Public Health

1.41 **M.M.U.T.C.D.** Michigan Manual of Uniform Traffic Control Devices

2.00 DRAWINGS, SPECIFICATIONS, AND GENERAL INFORMATION

2.01 INTENT OF PLANS AND SPECIFICATIONS: The intent of the Plans and Specifications is that the Contractor furnishes all labor, materials, equipment, and transportation necessary for the proper execution of the work unless specifically noted otherwise. The Contractor shall do all work shown on the Plans, described in the Specifications, and all implied work considered necessary to complete the project in a substantial and acceptable manner, ready for use, occupancy, and / or operation by the City.

2.02 COORDINATION OF SPECIFICATIONS, PLANS AND SPECIAL PROVISIONS: The precedence of various parts of the Contract Documents are given below in the order of their priority for evaluating contract disputes.

1. Contract
2. Project Plans and Drawings
3. Special Instructions to Bidders
4. Project Specifications
5. City of Royal Oak Standard Specifications for Construction

Any table, gradation, size, dimension, rate, mix, method, nomenclature, pay item number, basis of payment or method of measurement shown on the plans, which is a variance with the Standard Specifications, shall be considered a supplement or amendment to the applicable specification.

In interpreting the Contract Documents, work describing materials or work which has a well-known technical or trade meaning, unless otherwise specifically defined in the Contract Documents, shall be construed in accordance with such well-known meaning recognized by Engineers and the trade.

2.03 DISCREPANCIES IN PLANS: Any discrepancies found between the Plans and Specifications and site conditions, and any errors or omissions in the Plans and Specifications must be immediately reported to the Engineer who shall promptly correct such discrepancies, errors, or omissions in writing. Any work done by the Contractor after his discovery of such discrepancies, errors, or omissions shall be done at the Contractor's risk.

2.04 ADEQUACY OF PLANS AND SPECIFICATIONS: The location and general character of the work embraced in this Contract are shown upon the Plans. Responsibility for adequacy of the design and for sufficiency of the Plans and Specifications shall be borne by the City. Additional drawings showing detail, in accordance with which the work is to be constructed, may be furnished from time to time by the Engineer if required. These drawings, taken together, constitute the Plans for the work and are an essential part of the Contract. The work shall be executed in strict conformity with the Plans and Specifications and the approved shop drawings.

2.05 **USE OF UNDERGROUND INFORMATION**: The Contractor hereby agrees to accept full responsibility for his conclusions relative to the nature and probable difficulties of the work, using in part such underground information as the City has obtained and furnished; and the Contractor hereby waives all claims for any damages which he may suffer by reason of the inadequacy or incompleteness of any such data. The making of test borings by the City is not to be construed as relieving the Contractor of his obligation to make such supplementary or independent investigation as he may deem necessary or desirable. Locations of existing underground utilities shown on the plans represent the information at hand when the Plans were prepared and shall not be taken as conclusive evidence of either the exact locations of such utilities or the completeness of such information at the time of executing of the Contract.

2.06 **PROTECTION OF STAKES AND MONUMENTS**: The Contractor shall have the responsibility to carefully preserve bench marks, reference points and stakes and, in the case of destruction thereof by the Contractor of any of his employees, resulting from his negligence, the Contractor shall be charged with the expense and damage resulting therefore and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.

When staking is the City's responsibility: should it become necessary in the prosecution of the work to remove basic horizontal or vertical control points or marks that are a part of the public records and that are located outside of the normal work area, the Contractor shall notify the Engineer in ample time to permit him to obtain such additional information as may be necessary to replace or transfer said points to other locations.

2.07 **ADDITIONAL INSTRUCTIONS**: Further instructions may be issued by the Engineer during the progress of the work by means of drawings, notices, or Contract Modifications to clarify the Plans or Specifications or to correlate the work to unforeseen local situations or working conditions. The Engineer's instructions shall be confirmed in writing upon request from the Contractor.

2.08 **PLANS AND SPECIFICATIONS FURNISHED**: Except as provided for otherwise, all required copies of Plans and Specifications necessary for the execution of the work shall be furnished to the Contractor without charge.

2.09 **PLANS AND SPECIFICATIONS AT JOB SITE**: One complete set of all Plans and Specifications, including approved shop drawings, shall be maintained at the job site and shall be available to the Engineer at all times. Approved Contract Modifications shall also be available at the job site. It is the Contractor's responsibility that their subcontractors and / or suppliers have been furnished with the latest Plans and Specifications.

2.10 **DIMENSIONS**: Dimensions shown in figures or which can be determined by computation from other figures shown, shall take precedence over dimension scaled from the drawings. When the work of the Contractor is affected by finished dimensions, these shall be determined by the Contractor at the site and he shall assume the responsibility therefor.

2.11 **LAND BY CITY, OWNER**: The City shall furnish all land and rights-of-way to be occupied by the project, and will use due diligence in acquiring said land and rights-of-way as speedily as possible. But it is possible that all lands and rights-of-way may not be obtained as herein contemplated before construction begins, in which event the Contractor shall begin his work upon such land and rights-of-way as the City may have previously acquired and no claim for damage whatsoever will be allowed by reasons of the delay in obtaining the remaining lands and rights-of-way, as long as work remains to be done on the project.

2.12. **LAND BY CONTRACTOR**: Any additional land and access that may be required for temporary construction facilities or for storage of materials shall be provided by the Contractor with no liability to the City.

2.13. **SANITARY REGULATIONS**: The Contractor shall provide and maintain adequate sanitary accommodations considered as part of the contract for the use of his employees and those of his subcontractors, properly secluded from public observations, and their use shall be strictly enforced. The Contractor shall vigorously prohibit the committing of nuisances about the work or upon adjacent private or public property.

2.14. **PRIVATE PROPERTY**: The Contractor shall restrict his operations to the public rights-of-way, City property or easements within private property. The Contractor shall not trespass on private property and he shall not use nor request the use of any utility, including water, from a property owner. Where the plans indicate work outside of an easement on private property, or when the Engineer directs the Contractor to perform work outside of an easement, the City will secure a permit from the property owner prior to the commencement of work.

Any damage to private property caused by the Contractor's operations shall be remedied by the Contractor. The Contractor shall be responsible to resolve all property damage or personal injury claims made against the Contractor during construction operation covered under the Contract. All property damage or personal injury claims shall be processed with the insurance company listed on the Certificate of Insurance for the Contract in a timely manner before the final estimate payment.

3.00 ENGINEER-CITY-CONTRACTOR RELATION

3.01 **ENGINEER'S RESPONSIBILITY AND AUTHORITY**: All work shall be done under the general supervision of the Engineer. The Engineer shall decide any and all questions which may arise as to the quality and acceptability of the material furnished, work performed, rate of progress of work, interpretation of Plans and Specifications, and all questions as to the acceptable fulfillment of the Contract on the part of the Contractor.

This responsibility and authority shall be confined to the direction or specification of what is to be accomplished under this Contract, and shall not extend to the actual execution of the work, which shall be under the control of the Contractor, and for which the Contractor is alone responsible. The Engineer shall have the authority, with the approval of the City, to change the Plans and order Extra Work. The Engineer has sole agency to act on behalf of the City with regard to the direction of this work.

Communications of the Contractor to the City or by the City to the Contractor shall be directed through the Engineer.

3.02 **ENGINEER'S DECISIONS**: All claims of the City or the Contractor shall be presented to the Engineer for decision. The decision shall be made in writing within a reasonable time. All decisions of the Engineer shall be final except in cases where time and / or financial considerations are involved, in which case the decision shall be subject to arbitration.

3.03 **SUSPENSION OF WORK**: The Engineer shall have the authority to suspend the work, wholly or in part, for such period or periods, as he may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for prosecution of the work, or failure on the part of the Contractor to carry out the provisions of the Contract or to supply materials to meet the requirements of the Specifications. The Contractor shall not suspend operations for more than 72 hours without the Engineer's permission.

3.04 **ARBITRATION**: Should there be any dispute or any questioned decision or action by the City, the Engineer or the Contractor which involves the application or interpretation of any section of this Contract which is subject to arbitration, it shall be promptly submitted to arbitration upon demand by either party to the dispute. The Contractor shall not delay the work because arbitration proceedings are pending unless he shall have written permission from the Engineer to do so and such delay shall not extend beyond the time when the arbitrators shall have opportunity to determine whether the work shall continue to be suspended pending decision by the arbitrator to such a dispute. Any demand for arbitration shall be in writing and shall be delivered to the Engineer and any adverse party by registered mail addressed to the last known address of each within ten (10) days of receipt of the Engineer's decision, and in no event after final payment has been made and accepted, subject, however, to any express stipulation to the contrary in the Contract Documents. Should the Engineer fail, within a reasonable period, to make a decision, a demand for arbitration may then be made as if the Engineer's decision has been rendered against the party demanding arbitration.

The arbitrators, if they deem that the case demands it, are authorized to award to the party whose contention is sustained, such sums as they shall deem proper for the expenses incident to the appeal but unless the award of the arbitrators is to the contrary, the reasonable compensation and expenses of the arbitrator shall be shared equally by the parties involved.

No one shall be qualified to act as an arbitrator who has, directly or indirectly, any financial interest in the Contractor, who has any business or family relationship with the City, the Contractor, or the Engineer.

Each arbitrator selected shall be qualified by experience and knowledge of the work involved in the matter to be submitted to arbitration.

All claims, disputes and other matters in questions arising out of or relating to this Agreement except claims which have been waived by the making or acceptance of final payment shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association. Any reward rendered hereunder shall be final and judgment may be entered based upon said award in accordance with the Michigan Statutes and General Court Rules pertaining thereto. Any award rendered hereunder may be vacated solely upon the grounds specified in said statue and court rules and in addition on the basis that the award is contrary to law.

3.05 **INSPECTION**: All materials in each part or detail of the work shall be subject at all times to inspection by the Engineer. Such inspection may include mill, plant, or shop inspection, and any material furnished under these specifications is subject to such inspection. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as required to perform a complete and detailed inspection.

3.06 **EXAMINATION OF COMPLETED WORK**: If the Engineer requests, the Contractor at any time before acceptance of the work shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portion of the work to the standard required by the Specifications. Should the work thus exposed or examined prove acceptable; the uncovering or removing, and replacing of the covering or making good of the parts removed shall be paid for as extra work, but should the work so exposed or examined prove unacceptable, the uncovering, removing and replacing shall be at the Contractor's expense.

3.07 **GENERAL INSPECTION**: The Contractor shall notify the Engineer as to the exact time at which he proposes to begin any part of the work at least 48 hours in advance of any such start, so that the Engineer may provide for inspection by the resident engineer and / or inspectors under his direction, of all materials used and all work done under this Contract.

Inspectors shall have authority to reject defective material and to suspend any work that is being done improperly, subject to the Engineer's decision. They shall have no authority to permit deviation from, or to relax or extend, any of the provision for the Specifications without written permission from the Engineer.

3.08 **SUGGESTIONS TO CONTRACTOR ADOPTED AT HIS OWN RISK**: Any plan or methods of accomplishing the work suggested to the Contractor by the Engineer or other representative of the City, but not specified or required, shall be used at the Contractor's own risk and responsibility. The Engineer and the City assume no responsibility therefor.

3.09 **CONTRACTOR'S RESPONSIBILITY**: The Contractor shall assume and have sole charge of and responsibility for all work included in this Contract until the termination thereof, unless otherwise specified in this Contract, and shall be solely liable for all damaged occasions in any way by his act or neglect, or that of his agents, employees, workmen, or any person or persons in or about the work embraced in this Contract.

3.10 **CONTRACTOR'S SUPERINTENDENCE**: A qualified superintendent, who is acceptable to the Engineer, shall be maintained on the work and give efficient supervision to the work until its completion. The superintendent shall have full authority to act on behalf of the Contractor, and all directions given to the superintendent shall be considered given to the Contractor.

3.11 **ASSIGNMENT OF CONTRACT**: Neither the Contractor nor the City shall sublet, sell, transfer, assign or otherwise dispose of the Contract or any portion thereof, or his right, title or interest therein, or his obligations thereunder, without written consent of the other party.

3.12 **CITY'S RIGHT TO CORRECT DEFICIENCIES**: Upon failure of the Contractor to perform the work in accordance with the Contract Documents, including any requirements with respect to the schedule of completion, the City may, without prejudice to any other remedy it may have, correct such deficiencies, beginning such work not less than five (5) days from the date of serving written notice to the Contractor and his Surety of his intent to do so.

3.13 **CITY'S RIGHT TO TERMINATE CONTRACT AND COMPLETE THE WORK**: The City may terminate the employment of the Contractor in the event of any default by the Contractor and upon receiving written notice from the Engineer certifying cause for such action, after given ten (10) days written notice of termination to the Contractor.

The Contractor shall be considered in default whenever he shall:

A. Declare bankruptcy, become insolvent, or assign his assets for the benefit of his creditors.

B. Disregard or violate important provisions of the Contract Documents or Engineer's instructions, or fail to prosecute the work according to the agreed schedule of completion, including extensions thereof, or unnecessarily or unreasonable delaying the performance of completion of the work.

C. Fail to provide a qualified superintendent, competent workmen or subcontractors, or proper materials, or fail to make proper payment therefore.

Prior to any action by the City to terminate the Contract and finish the work, it shall serve written notice upon the Surety, and the Surety shall have the right to take over and perform the Contract, provided, however, that if the Surety does not commence performance thereof in thirty (30) days from the date of the mailing to such Surety of notices of termination, the City may take over the work and prosecute the same to completion by Contract for the account and at the expense of the Contractor, and the Contractor and the Surety shall be liable to the City for any extra cost occasioned to the City thereby.

In the event of such termination, the City may take possession of the work and all materials, tools, and equipment thereon, and may finish the work by whatever methods and means it may select.

3.14 **CONTRACTOR'S RIGHT TO SUSPEND WORK OR TERMINATE CONTRACT**: The Contractor may suspend work or terminate the Contract upon any of the following reasons:

A. If an order of any court, or other public authority, causes the work to be stopped or suspended for a period of ninety (90) days through no act or fault of the Contractor or his employees.

B. If the Engineer should fail to act on any request for payment within ten (10) days after it is presented in accordance with the General Conditions of the Contractor.

C. If the City should fail to act upon any request for payment within thirty (30) days after its approval by the Engineer.

D. If the City should fail to pay the Contractor any sum within thirty (30) days after its award by arbitrators.

E. If the City fails to provide land to be occupied by the project.

3.15 **RIGHTS OF VARIOUS INTERESTS**: Whenever work being done by the City's forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Engineer, to secure the completion of the work in general harmony.

3.16 **SEPARATE CONTRACTS**: The City may let other contracts in connection with the work of the Contractor. The Contractor shall cooperate with other contractors with regard to storage of materials and execution of their work and shall carefully fit his own work to that provided under such other contracts. It shall be the Contractor's responsibility to inspect all work by other contractors affecting his work and to report to the Engineer any irregularities which will not permit him to complete his work in a satisfactory manner. His failure to notify the Engineer of such irregularities shall indicate the work of other contractors has been satisfactorily completed to receive his work. The Contractor shall not be responsible for defects of which he could not have known which develop in the work of others after the work is completed. The Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor.

3.17 **SUBCONTRACTORS**: The Contractor shall submit to the Engineer for approval by the City, the names of subcontractors proposed for the work. The Contractor shall not employ any subcontractors that the City objects to as incompetent or unfit. Subcontractors may not be changed except at the request or with the approval of the City.

If the Contractor has submitted, as a part of his proposal, a list of subcontractors, and the change of any name on such list is required by the City after execution of the Agreement, the contract price shall be increased or diminished by the difference in cost occasions by such change.

The Contractor is responsible to the City for the acts or omissions of his subcontractors, and of their direct and indirect employees. The Contract Documents shall not be construed as creating any contractual relationship between any subcontractor and the City.

The Contractor shall bind every subcontractor by the terms of the Contract Documents and every subcontractor shall be bound by the terms of the Contract Documents as far as applicable to his work, unless specifically noted to the contrary.

For convenience of reference, the Specifications are separated into titled sections. Such separations shall not, however, operate to make the Engineer arbiter to establish limits of the contracts between Contractor and subcontractors.

3.18 **WORK DURING AN EMERGENCY**: The Contractor shall perform any work and shall furnish and install any materials and equipment necessary during an emergency endangering life or property. In all cases, he shall notify the Engineer of the emergency as soon as practicable, but he shall not wait for instructions before proceeding to protect both life and property.

The Contractor shall immediately stop all construction operations and notify the City of Royal Oak Fire Department and appropriate utility company in the case of leaking gas mains, leaking gas services, electrical wires either downed or dug up, or any other potentially hazardous condition.

The Contractor shall not seek to recover damages or monies from the City of Royal Oak for Contractor down time during potentially hazardous conditions.

3.19 **ORAL AGREEMENTS**: No oral order, objection, claim or notice by any party to the others shall effect or modify any of the terms or obligations contained in any of the Contract Documents, and none of the provisions of the Contract Documents shall beheld to be waived or modified by reason of any act whatsoever, other than by a definitely agreed waiver or modification thereof in writing, and no evidence shall be introduced in any proceeding of any other waiver or modification.

4.00 MATERIALS AND WORKMANSHIP

4.01 **MATERIALS BY THE CONTRACTOR**: The Contractor shall furnish all material necessary for the completion of the work unless portions of the required material are specifically set up for the City to furnish. It shall be the Contractor's responsibility to prove to the City that all materials furnished are in full compliance with the requirements of the Contract. All materials and equipment incorporated in the work shall be new.

4.02 **MATERIALS BY THE CITY, OWNER**: The fact that the City is to furnish material is conclusive evidence of its acceptability for the purpose intended, and the Contractor may continue to use it unless otherwise directed. If the Contractor discovers any defects in materials furnished by the City, he shall notify the Engineer before installing said material in the structure.

4.03 **STORAGE OF MATERIALS**: Materials shall be so stored as to insure the preservation of their quality and fitness for the work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and / or placed under cover. Stores of materials shall be so located as to facilitate prompt inspection and shall not be located as to affect pedestrian or vehicular traffic. The Contractor shall not store or place materials on private property. The Contractor shall not store or place materials in City parks without obtaining written permission from the Engineer.

4.04 **SAMPLES**: All samples called for in the Specifications or required by the Engineer shall be furnished by the Contractor and shall be submitted to the Engineer for his approval. Samples shall be furnished so as not to delay fabrication, allowing the Engineer a reasonable time for the consideration of the samples submitted.

4.05 **QUALITY OF EQUIPMENT AND MATERIALS**: In order to establish standards of quality, the Engineer has, in the Project Specifications and / or on the Plans, referred to certain products by name and catalog number. This procedure is not to be construed as eliminating from competition other products of equal or better quality which are fully suitable in design. The specific article, material, or equipment mentioned shall be understood as indicating the type, function, minimum standard of design, efficiency and quality desired and shall not be construed in such a manner as to exclude manufacturer's products of comparable quality, design and efficiency.

If the Contractor desires to use materials other than those specified:

A. He shall furnish a complete list of desired substitutions together with such Engineering and catalog data as the Engineer may require prior to ordering any such substitutions.

B. He shall defer to the Engineer's judgment when proposed substitute materials or items of equipment are judged to be unacceptable and shall furnish the specified material or items of equipment in such case.

All proposals for substitutions shall be submitted in writing by the Contractor and not by individual trades or material suppliers.

The Engineer will approve or disapprove proposed substitutions in writing within thirty (30) days. No substitute materials shall be used unless approved in writing.

4.06 **EQUIPMENT APPROVAL DATA**: The Contractor shall furnish six (6) copies of complete catalog data for every manufacturer's item of equipment and all components thereof to be used in the work, including specific performance data, material gage or thickness, brand name, catalog number, etc. This submission shall be compiled by the Contractor and approved in writing by the Engineer before any of the equipment is ordered. Each data sheet or catalog in the submissions shall be indexed according to Specification Section and Paragraph for easy reference. After written approval, this submission shall become a part of the Contract and may not be deviated from except upon the written approval of the Engineer.

Catalog data for equipment approved by the Engineer does not in any case supersede the Engineer's Contract Documents. The approval of the Engineer shall not relieve the Contractor from any responsibility for deviation from Plans or Specifications, unless he has in writing called the Engineer's attention to such deviation at the time of submission, nor shall it relieve him from responsibility for errors of any sort in the item submitted. The Contractor shall check the catalog data with Engineer's Contract Documents for deviations and errors.

It shall be the responsibility of the Contractor to insure that items be furnished to fit the space available. He shall make necessary field measurements to ascertain space requirements, and shall notify the Engineer in the event of any conflict.

Where equipment requiring different arrangements of connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the intent of the Plans and Specifications, and to make all changes in the work required by the different arrangement of connections.

The Contractor shall provide the Engineer with equipment rental rates determined by the current MDOT Blue Book per Schedule C for equipment approved for cost-plus work per section 7.05 D of the General Conditions.

4.07 **SHOP DRAWINGS**: The Contractor shall provide shop drawings, settings, schedules and such other drawings as may be necessary to determine conformity of buyout items with the Plans, Specifications or Engineer's constructions. Deviations from the Plans

and Specifications shall be called to the attention of the Engineer at the time of the first submission of shop drawings and other drawings for approval. The Engineer's approval for any drawings shall not release the Contractor from responsibility for such deviations. Shop Drawings shall be submitted according to the following schedule:

A. Six (6) copies shall be submitted in sufficient time to secure final approval and delivery of materials before the materials indicated thereon are to be needed in order to prevent delay of the work.
B. The Engineer shall within fourteen (14) days of the submittal of any shop drawings, return three (3) copies to the Contractor marked with all corrections and changes required to secure conformance with the Plans and Specifications.
C. The Contractor shall then correct the shop drawings to conform to the corrections and changes requested by the Engineer, and return six (6) copies to the Engineer for final approval.
D. The Engineer shall, within fourteen (14) days of the submittal of corrected shop drawings, return three (3) copies to the Contractor marked with any additional corrections and changes, or marked as approved.
E. Following receipt of approved shop drawings, the Contractor shall order his materials.

4.08 **MANUFACTURER'S DIRECTIONS**: Manufactured articles, material and equipment shall be applied, installed, connected, erected, tested, programmed, cleaned and conditioned as directed by the manufacturer unless herein specified to the contrary.

4.09 **CHARACTER OF WORKMEN**: The Contractor shall at all times be responsible for the conduct and discipline of his employees and / or any subcontractor or persons employed by subcontractors. All workmen must have sufficient knowledge, skill, and experience to perform properly the work assigned to them. Any foreman or workman employed by the Contractor or subcontractor who, in the opinion of the Engineer, does not perform his work in a skillful manner, or appears to be incompetent or to act in a disorderly or intemperate manner shall, at the written request of the Engineer, be discharged from the work and shall not be employed again in any portion of the work without the approval of the Engineer. If any employee is not immediately removed when required, any work done by the Contractor after the employee's requested discharge will not be estimated or accepted.

The Contractor and its' subcontractors shall have and administer a Drug-Free Workplace Policy. The purpose is to provide a workplace that is free from substance abuse. Workers under the influence of drugs or alcohol cannot work safely, productively and jeopardizes the welfare and safety of the jobsite. The following guidelines list violations which shall be grounds for immediate action:

A. A worker who possesses, uses, distributes, sells, or offers for sale narcotics, or any controlled illegal substance, including marijuana, while on duty.

B. Report for work or work while under the influence of alcohol, narcotics or any controlled or illegal substance, including marijuana, except a drug prescribed for the employee by a licensed physician.
C. A worker taking a physician prescribed drug whose ability to work is impaired.

4.10 **REJECTED WORK AND MATERIALS**: All materials which do not conform to the requirements of the Contract Documents, or are not equal to samples approved by the Engineer, or are in any way unsatisfactory or unsuited to the purpose for which they are intended shall be rejected and immediately removed from the site of the work. Any defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness or other cause, shall be removed with ten (10) days after written notice is given by the Engineer, and the work shall be re-executed by the Contractor. The fact that the Engineer may have previously overlooked such defective work shall not constitute an acceptance of any part of it.

4.11 **CUTTING AND PATCHING**: The Contractor shall do all necessary cutting and patching of the work that may be required to properly receive the work of the various trades or as required by the Plans and Specifications to complete the structure, and shall make good after them as may be directed by the Engineer. Any cost caused by defective or ill-timed work shall be borne by the party responsible therefor.

4.12 **CLEANING UP**: The Contractor shall remove from the City's property, and from all public and / or private property, all temporary structures, all rubbish, waste materials, excess dirt and broken concrete resulting from his operations or caused by his employees, and all surplus materials, leaving the site smooth, clean and true to line and grade by the end of each work day. At the termination of this Contract, before acceptance of the work by the Engineer, the Contractor shall remove all of his equipment, tools and supplies from the property of the City. Should the Contractor fail to remove such equipment, tools and supplies, materials debris, excess dirt, and broken concrete, the City shall have the right to remove them and the Contractor shall reimburse the City for all expenses incurred. Materials and dirt required for backfill shall be properly barricaded and not an obstacle for the public.

The Contractor shall systematically and thoroughly clean and make any needed repairs. Cleaning and repairing shall be arranged, insofar as practical, to be completed upon finishing the construction work. The Engineer will not prepare his final estimate of the work until the final inspection has been made. During this final inspection, the Contractor shall furnish such equipment and labor as may be necessary to accomplish and expedite same without additional compensation.

4.13 **GUARANTEE PERIOD**: The Contractor shall warrant all equipment furnished and work performed by him for a period of one (1) year from the date of written acceptance of the work.

5.00 INSURANCE, LEGAL RESPONSIBILITY AND PUBLIC SAFETY

5.01 **CONTRACT SECURITY**: The Contractor shall furnish a Performance and Guarantee Bond in an amount equal to at least 100% of the Contract price as security for the faithful performance of this Contract, unless otherwise specified in the Contract.

Bond forms for the aforementioned securities have been made a part of the Contract Documents and the Contractor shall ensure that each executed copy of the bond form is complete and sealed.

5.02 **INSURANCE**: The Contractor shall not commence work under the Contract until he has obtained the insurance required under the Contract. All provided coverages shall be with insurance companies licensed and admitted to do business in the State of Michigan. All coverages shall be with insurance carriers acceptable to the City of Royal Oak, Michigan.

5.03 **PROTECTION OF PROPERTY**: The Contractor shall be responsible for the preservation of all public property, trees, monuments, etc., exercising every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipe, conduits, and other underground structures, and shall protect carefully from disturbance of damage all monuments and property marks until an authorized agent has witnessed or otherwise referred their location and shall not remove them until directed.

5.04 **PERMITS**: Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured by the Contractor. Permits and licenses of a permanent nature will be secured by the City.

5.05 **NOTIFYING UTILITIES**: The Contractor shall notify all utilities that may possibly have existing facilities in the construction area, in writing, of his starting date **72 hours** (minimum) before work under the Contract commences. **Call Miss Dig 1-800-482-7171 or 811.** The Contractor shall comply with the requirements of Public Act. No. 53 of 1974 and all amendments.

5.06 **LAWS TO BE OBSERVED**: The Contractors shall give all notices and comply with all Federal, State and Local laws, ordinances and regulations, in any manner affecting the conduct of the work, and all such orders and decrees as exist, or may be enacted by bodies or tribunals having any jurisdiction or authority over the work, and shall indemnify and save harmless the City, against any claim or liability arising from, or based upon, the violation of any such law, ordinance, regulation, decree, whether by himself or his employees. Littering, burning, and drinking of alcohol on public property are in violation of City Ordinances. Violations will be reported to the City of Royal Oak Police Department.

5.07 **FAIR EMPLOYMENT PRACTICES ACT**: The Contractor agrees that neither he nor his subcontractors will discriminate against any employee or application for employment, to be employed in the performance of the Contract, with respect to his hire, tenure, terms, conditions or privileges of employment or any matter directly or indirectly related to employment because of his race, color, religion, national origin or ancestry, or because of age or sex except where based upon a bona fide occupational qualification. Breach of this covenant may be regarded as a material breach of the Contract, (Aft 251 P.A. Mich. 1955).

5.08 **WARNING SIGNS AND BARRICADES**: The Contractor shall provide adequate signs, barricades, lights, traffic regulator personnel (flagmen and watchmen) and take all necessary precautions for the protection of the work and the safety of the public. All barricades and obstructions shall be protected at night by adequate approved properly lighted / reflective barricading and fencing as required from sunset to sunrise. Barricades shall be of suitable construction and shall be maintained and kept clean to increase their visibility at night.

Suitable warning signs shall be so placed and illuminated at night as to show in advance where construction, barricades, or detours exist. The Contractor shall maintain one lane of traffic in each direction in the construction area where directed by the Contract or City Engineer. All signing and barricading shall be done in accordance with **Public Act 315 of 2003 effective April 8, 2004** the provisions of Sections 1.04.11 and 812 of the MDOT 2020 Standard Specifications for Construction and signing shall conform to the current edition of the **Michigan Manual of Uniform Traffic Control Devices** except as otherwise specified herein and shall be approved by the Engineer.

5.09 **PUBLIC SAFETY AND CONVENIENCE**: The Contractor shall at all times so conduct his work to ensure the least possible obstruction to traffic and inconvenience to the general public and the residences in the vicinity of the work, and to insure the protection of persons and property in a manner satisfactory to the Engineer. No road or street shall be closed to the public except with the permission of the Engineer and proper governmental authorities. The Contractor shall confer with and keep police and fire departments of the municipality fully informed as to streets or alleys which are to be closed to traffic for construction purposes. Fire hydrants on or adjacent to the work shall be kept accessible to firefighting equipment at all times. Temporary provisions shall be made by the Contractor where applicable to ensure the usability of sidewalks and the proper functioning of all gutters, sewer inlets and drainage ditches.

5.10 **SAFETY:** The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the project. Such responsibility does not relieve subcontractor of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety laws and regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

-all persons on the site or who may be affected by the project
-all the work and materials and equipment to be incorporated therein
-other property at the site or adjacent thereto

Contractor shall inform the Engineer of the specific requirements of the Contractor's safety program with which the Engineer's employees and representatives must comply while at the project site.

5.11 **PATENTS AND ROYALTIES**: The Contractor shall pay for all royalties and patents in connection with the work except that the City will pay for any license fee or royalties for processes involved in this operation facilities.

6.00 PROGRESS AND COMPLETION OF WORK

6.01 **SUNDAY, HOLIDAY AND NIGHT WORK**: In general, no work shall be done between the hours of 8:00 p.m. and 7:00 a.m., nor on holidays or Sunday, except as it is necessary for the proper care and protection of work already performed or, in the case of an emergency.

6.02 **ORDER OF WORK AND SCHEDULE OF COMPLETION**: The Contractor shall submit, as such times as may reasonably be requested by the Engineer, schedules which show the order in which the Contractor proposed to carry on the work and tentative dates for

starting and completing each major item of work. Upon approval, the schedule shall be adhered to as closely as practical in prosecuting the work.

6.03 **RECORD DOCUMENTS**: Contractor shall maintain in a safe place at the project one record copy of all drawings, specifications, addenda, contract modifications, and other written directives and clarifications in good order and annotated to show changes made during construction. These record documents shall be available to the Engineer for reference. Upon completion of the project, the record documents shall be delivered to the Engineer.

6.04 **CHANGES IN THE WORK**: The Engineer may, with the approval of the City, as the need arises, order changes in the work in the form of Contract Modifications without invalidating the Contract. Compensation and time of completion affected by the Contract Modifications shall be adjusted at the time of ordering such changes (see section 7.05 for payment).

If the Contractor claims that any instructions by drawings or otherwise involve extra costs under this Contract, he shall give the Engineer written notice thereof within ten (10) days after receipt of such instructions and in any event before proceeding to execute the work, except in an emergency endangering life and property. No claim for extra work will be considered in the absence of a written Contract Modification.

Extra work shall be performed in accordance with these Specifications where applicable and work not covered by the Specifications or Special Provisions shall be done in accordance with the best practice as approved by the Engineer. Extra work required in an emergency to protect life and property shall be performed by the Contractor as required.

Deviations from the Contract Documents cannot be authorized by an inspector. Any deviations to the work must be authorized in writing by a City Engineer, by means of an executed speed letter / work order.

Construction operations completed outside of Contract specifications shall be done at the Contractor's own risk and shall not relieve the Contractor from fulfilling the obligations of the Contract Documents.

6.05 **CLAIMS**: All claims shall be referred to the Engineer for decision. A decision by the Engineer shall be required as a condition precedent to any exercise by the Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such claims.

Written notice stating the general nature of each claim shall be delivered by the claimant to the Engineer promptly (but in no event later than 30 calendar days) after the start of the event giving rise thereto. The responsibility to substantiate a claim shall rest with the party making the claim. Notice of the amount or extent of the claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless the Engineer allows additional time for claimant to submit additional or more accurate data in support of such claim).

Each claim shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of

said event. The opposing party shall submit any response to the Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless the Engineer allows additional time).

The Engineer will review each claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

- deny the claim in whole or in part;
- approve the claim; or
- notify the parties that the Engineer is unable to resolve the claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the claim, such notice shall be deemed a denial.
- In the event that the Engineer does not take action on a claim within said 30 days, the claim shall be deemed denied.

The Engineer's written action or denial will be final and binding upon the Owner and Contractor, unless the Owner or Contractor invoke the dispute resolution procedure within 30 days of such action or denial.

No claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph.

6.06 **EXTENSION OF CONTRACT TIME**: A delay beyond the Contractor's control, occasions by an Act of God, or act or omission on the part of the City, or by strikes, lockouts, fire, etc., may entitle the Contractor to an extension of time in which to complete the work, provided, however, that the Contractor shall within **five (5) days** following the beginning of such delay give written notice to the Engineer of the cause of such delay and of his intention to request an extension of time because of the delay. Extensions of time will only be granted by formal Contract Modifications. The Contractor is advised that normal seasonal weather conditions and delays in securing equipment and materials will not be considered adequate grounds for an extension of time.

6.07 **USE OF COMPLETED PORTIONS**: The City shall have the right to take possession of and use any completed or partially completed portions of the work, notwithstanding that the time for completing the entire work of such portions may not have expired; that such taking possession and use shall not be deemed as acceptance of any work not completed in accordance with the Contract Documents. If such prior use increases the cost of or delays the completion of uncompleted work or causes refinishing of completed work, the Contractor shall be entitled to such extra compensation, or extension of time or both, as the Engineer may determine.

7.00 MEASUREMENT AND PAYMENT

7.01 **DETAILED BREAKDOWN OF CONTRACT AMOUNT**: As follows:

A. In cases where a lump sum forms the basis of payment under the Contract, the Contractor shall, prior to and as a condition of the first partial payment, submit a complete breakdown of the contract amount showing the value assigned to each part of the work, including an allowance for profit and overhead. Upon approval of the

breakdown of contract amount by the Engineer, it shall be used as a basis for all progress payments.

B. To assure proper performance of a construction contract by the Contractor, the City shall retain a portion of each progress payment otherwise due as provided in the Contract Documents.

7.02 **PAYMENT FOR IMPLIED WORK**: Implied work shall be deemed to be included in this Contract and shall be furnished by the Contractor the same as if the same had been stated specifically, without any additional charge to the City.

7.03 **PAYMENT FOR UNCORRECTED WORK**: Should the Engineer order the Contractor to leave in place work that has been damaged or that was not performed in accordance with the Contract Documents, an equitable deduction in the contract amount shall be made to compensate the City for the uncorrected work.

7.04 **PAYMENT FOR REJECTED WORK AND MATERIALS**: The removal of work and materials rejected under section 4.10 and any resulting re-execution of acceptable work by the Contractor shall be at the expense of the Contractor, and he shall pay the cost of replacing the work of other contractors destroyed or damaged by the removal of the rejected work or materials or the subsequent replacement of acceptable work.

7.05 **PAYMENT FOR CONTRACT MODIFICATIONS**:
Contract Modification shall specify any extension of the contract time and one of the following methods of payment:

A. Unit prices or combination of unit prices which formed the basis of the original Contract.
B. Supplemental proposal giving an amended schedule of process covering the additional items of work.
C. A lump sum based on the Contractor's estimate, approved by the Engineer, and accepted by the City.
D. A "Cost-Plus" basis defined as the cost of labor and documented cost of fringe benefits, materials and equipment rental, plus 15% of said cost to cover superintendence, general overhead and profit. Extra work performed by subcontractors shall be computed the same as above, plus a 5% allowance calculated before superintendence, general overhead and profit for the General Contractor. Costs furnished to the Engineer by the Contractor for labor and equipment used on any extra work to be paid on a "Cost-Plus" basis shall be the actual rate of wages paid as certified by the payroll supervisor and the Rental Rate Blue Book For Construction Equipment, Volume No. 1, 2 or 3 as applicable; the edition which is current at the time the extra work was started will apply.

7.06 **PROCEDURES OR EXECUTING WORK UNDER COST-PLUS METHOD OF PAYMENT**: During the progress of any extra work which is to be paid for on the basis of "Cost-Plus", the Contractor will furnish to the Engineer at the end of each day, suitable time slips, showing the name of and the number of hours worked by each workman employed thereon, the nature of the work performed by him, and his rate of pay, together with suitable and adequate memorandum of the materials used therein, and showing the character and amount of such materials, the source of which it was purchased, and the price paid, or to be paid therefor. The City may, at its discretion, furnish to the Contractor any materials or supplied required for extra work, and the

Contractor shall not be entitled to receive allowance or percentage on account of materials or supplies so furnished.

7.07 **PAYMENT FOR WORK BY THE CITY**: The cost of the work performed by the City in removing construction equipment, tools and supplies in accordance with section 4.12 and in correcting deficiencies in accordance with section 3.12 shall be paid by the Contractor within thirty (30) days after receipt of an invoice thereof.

If the Contractor does not pay the expenses of such removal and after ten (10) days written notice being given by the City of its intent to sell the material, the City may sell the material at auction or at private sale and shall pay to the Contractor the net proceeds after deducting all the costs and expense that should have been borne by the Contractor.

7.08 **PAYMENT FOR WORK BY THE CITY FOLLOWING ITS TERMINATION OF THE CONTRACT**: Upon termination of the Contract by the City in accordance with section 3.13, no further payments shall be due the Contractor until the work is completed. If the unpaid balance of the Contract amount shall exceed the cost of completing the work, including all overhead costs, the excess shall be paid to the Contractor. If the cost of completing the work shall exceed the unpaid balance, the Contractor shall pay the difference to the City. The cost incurred by the City, as herein provided, and the damage incurred through the Contractor's default, shall be certified by the City and approved by the Engineer.

7.09 **PAYMENT FOR WORK TERMINATED BY THE CONTRACTOR**: Upon suspension of the work or termination of the Contract by the Contractor in accordance with section 3.14, the Contractor shall recover payment from the City for the work performed, plus loss on plan and materials plus 10% profit and established damages, as approved by the Engineer.

7.10 **RELEASE OF LIENS**: The Contractor shall deliver to the City a complete release of all liens arising out of this Contract before the retained percentage or before the final request for payment is paid. If any lien remains unsatisfied after all payments have been made, the Contractor shall refund to the City such amounts as the City may have been compelled to pay in discharging such liens, including all costs and reasonable attorney's fees. The Contractor shall execute the "Contractor's Affidavit" form as shown as follows:

Contractor's Affidavit

State of _____)
)
County of _____)

The undersigned, _____ hereby represents that on the _____ day of _____ 20___, it was awarded a Contract by the City of Royal Oak, hereinafter called the Owner, to perform work as specified under _____, and the undersigned further represents that the subject work has now been accomplished and the said Contract has now been completed.

The undersigned hereby warrants and certifies that all of its indebtedness arising by reason of the said Contract has fully been paid or satisfactorily secured; and that all claims from subcontractors and others for labor and material used in accomplishing the said project, as well as all other claims arising from the performance of the said Contract, have been fully paid or satisfactorily settled. The undersigned further agrees that, if any such claim should hereafter arise, it shall assume responsibility for the same immediately upon request to do so by the Owner.

The undersigned, for a valuable consideration, the receipt of which is hereby acknowledged, does further hereby waive, release and relinquish any and all claims or right of lien which the undersigned now has or may hereafter acquire upon the subject premises for labor and material used in accomplishing said project owned by the Owner.

This affidavit is freely and voluntarily given with full knowledge of the facts, on this _____day of _____, 20_____.

Contractor: _____

By: _____

Title: _____

Subscribed and sworn to before me, a Notary Public

in and for _____ County, _____.

on this _____ day of_____, 20___.

_____

Notary Public

My Commission expires _____

7.11 **TERMINATION OF CONTRACTOR'S RESPONSIBILITY**: The Contract will be considered complete when all work has been finished, the final inspection made by the Engineer, and the project accepted in writing by the City. The Contractor's responsibility shall then cease, except as set forth in his Performance Bond, as required by the Guarantee period in accordance with section 4.13 and as provided in section 7.12.

7.12 **CORRECTION OF FAULTY WORK AFTER FINAL PAYMENT**: The approval by the Engineer of the final request for payment and the making of the final payment by the City to the Contractor shall not relieve the Contractor of responsibility for faulty materials or workmanship and the Contractor shall promptly replace any such defects discovered within one (1) year from the date of written acceptance of the work.

7.13 **PROGRESS PAYMENTS AND ESTIMATES**: At the end of each month or at such other time intervals as may be mutually agreeable, the Engineer will make an estimate of the quantity and value of the work done by the Contractor since the date of the previous estimate, and as soon as practicable thereafter the City will pay the Contractor, as a partial payment, not less than 80% of the amount of such estimate, except that the City may at any time retain from such partial payments a sum sufficient to meet any undischarged indebtedness of the Contractor in connection with the work performed. Payments shall be made in accordance with Public Act No. 524 of 1980 and all amendments.

7.14 **FINAL ESTIMATE AND PAYMENT**: As soon as practicable after completion of all work included in this Contract, and after all known defects and deficiencies have been remedied, the Engineer will make a final inspection of said work and prepare a final estimate of the amount of money due to the Contractor. The Contractor shall file with the Engineer, as a condition precedent to final payment, an affidavit that all payrolls, material bills, and all other indebtedness incurred by them in connection with the work have been paid, or an affidavit showing in detail the nature and amount of any such indebtedness that is unpaid. The City shall hold from final payment an amount of money sufficient to meet any such undischarged indebtedness of the Contractor until an affidavit that such indebtedness is paid if filed with the Engineer.

The City may also withhold from final payment an amount of money, not to exceed 10% of the total contract price for not more than six months as security against hidden defects in the work included in the Contract. If at the end of said six month period, no such defects have been discovered, the City shall make payment to the Contractor of any such money withheld. If, at the end of such period, such defects have been discovered, the City may continue to withhold said sum of money until any such defects have been repaired by the Contractor, or may use such money to make the necessary repairs and pay to the Contractor any money unexpended.

GENERAL SPECIFICATIONS FOR MATERIALS TESTING

1.00 GENERAL PROVISIONS

1.01 **WORK INCLUDED**: The Contractor shall furnish all materials reasonably required for testing purposes; labor for taking, preparing and assembling samples, transportation of samples to testing laboratories; and analysis by independent testing laboratories.

1.02 **TESTING LABORATORY**: Selection of the testing laboratory will be made by the City.

1.03 **REPORTS REQUIRED**: The Engineer and Contractor will require an electronic copy of all laboratory reports.

1.04 **TESTS REQUIRED**: All testing shall follow A.S.T.M. procedures and requirements. In general, the following will be the minimum test required:

A. **Cement** - Certificates of tests by producer or by independent laboratory as required by the Engineer.

B. **Concrete aggregates and Mortar Sand** - Certified tests by producer or independent laboratory as required by the Engineer.

C. **Concrete** - will be tested by independent agency. For each concrete mixture being used, at least five standard cylinders 6" by 12" or 4" by 8"-inch (3 day break, 7 day break, 28 day breaks (2) and a spare) shall be taken each day. The cylinder diameter shall be at least 3 times nominal maximum size of coarse aggregate (ASTM C31/C31M). The point, time and method of securing these samples shall be done in accordance with ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete. The cylinders shall be made and cured in accordance with ASTM C31/C31M Standard Practice for Making and Curing Concrete Test Specimens in the field. The cured test specimens shall be tested at three, seven and twenty-eight (28) days, unless otherwise requested by the Engineer. Slump, air content, ambient air temperature and concrete temperature shall be tested in accordance with ASTM C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete, ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete, ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method, ASTM C173/C173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method. Concrete shall be tested every 100 cubic yards delivered to site or as directed by the Engineer to maintain the desired consistency of the concrete.

D. **Brick and Concrete Block for Manholes, Catch Basins, etc.**, - Visual inspection on site by the Engineer.

E. **Non-ferrous pipe** - Independent laboratory tests, 0.5% of each size and class; minimum of three pieces each size and class.

F. **Ferrous Pipe and Asbestos - Cement Water Main** - Certified tests by producer or independent laboratory as required by the Engineer.

G. **Reinforcing steel and miscellaneous metal** - Visual inspection on site by the Engineer for rust, dimensions, welding, shop painting, etc.

H. **Structural steel bolting and welding** – will be tested/inspected by an independent agency. Bolted connections will be inspected in accordance with the current RCSC Specification for Structural Joint Using High-Strength Bolts. Structural welds will be inspected by CWI (Certified Welding Inspector – AWS Certification)

1.05 **BASIS OF PAYMENT**: The City shall pay the fees charged by independent testing laboratories/agency for all performed testing and consulting in accordance with approved contract.

GENERAL SPECIFICATIONS FOR EXCAVATING AND BACKFILLING

1.00 GENERAL PROVISIONS

1.01 **WORK INCLUDED**: Work under this section shall consist of furnishing all materials, equipment and labor for excavating, trenching, shoring, sheeting, dewatering, bedding, backfilling, boring and jacking, disposal of unsuitable material, surface restoration, pavement replacement and special work below grade for construction.

1.02 **CONSTRUCTION SAFETY**: The Contractor shall alone be responsible for safety, efficiency and adequacy of his plant, appliances, equipment and methods, and for any damage which may result from their failure or their improper construction, maintenance or operation.

Job site and environs shall be regularly patrolled and maintained to reduce hazardous conditions.

Excavations and trenches left unattended shall be barricaded against pedestrians and vehicular traffic, backfilled, or adequately covered and fenced.

Construction equipment and excavated material shall be stocked in such locations that it does not obstruct vision on the traveled portion of the right-of-way and in such a manner that will not interfere with the flow of traffic. Excavated material shall be stockpiled in such locations that it does not obstruct roadway drainage. The Contractor is directly and solely responsible for disposal of all broken concrete, reinforcing steel, unsuitable material and debris.

1.03 **PROTECTION TO EXISTING UNDERGROUND LINES OR STRUCTURES**: Where service lines or structures are encountered which are in active use, the Contractor must provide adequate protection for them and will be held responsible for any damages to such utilities arising from his operations. The Contractor shall provide stand-by-utility service if temporary removal is necessary for a period exceeding two (2) hours.

Where utility service connections to occupied buildings must be temporarily disconnected, the Contractor shall give twenty-four (24) hours written notice to the affected occupants stating the time and duration of the anticipated shut-off.

1.04 **PUBLIC SAFETY**: The Contractor shall follow safe practices. In public rights-of-way, the Contractor shall provide sufficient traffic control, fencing and barricading in accordance with the current edition of the Michigan Manual of Uniform Traffic Control Devices. If traffic speed or volume warrant, the Contractor shall promptly furnish sufficient Traffic Regulator Personnel (flagmen) to effectively and safely direct traffic around or through the work area. In railroad, state highway, county highway or municipal street rights-of-ways, barricading, lighting and Traffic Regulator Personnel (flagmen) requirements shall meet standards of the agency having jurisdiction.

1.05 **CLEAN-UP**: Clean-up shall follow directly behind the pipe installation or at the end of every working day. The Contractor shall not delay the clean-up so that public use of streets is held up needlessly. Surface restoration (including pavement) is considered as

a part of the clean-up and the general provisions of "clean-up" apply. “Clean-up" shall mean:

A. Removing and hauling all excess fill, broken concrete, miscellaneous debris, litter, and other material generated by the project to a landfill approved by the City.

B. Obtaining rough grade in all lawn areas in preparation for lawn restoration.

C. Watering pavement with hoses from fire hydrants, then sweeping with a mechanical pick-up type street cleaner approved by the Engineer. The materials generated from sweeping shall become the property of the Contractor and removed from the project incidental to the Contract.

D. Sweeping public sidewalks.

1.06 SEASONAL CONSIDERATIONS AND CONSTRUCTION SCHEDULE: The Contractor shall prepare and present at the preconstruction meeting a detailed work schedule, and taking into consideration the following conditions:

A. Permanent pavement removal shall be limited to the period of March 15th to November 15th.

B. Permanent pavement replacement shall be limited to the period of April 1st to November 15th.

C. Severe weather conditions during January and February may cause the Engineer to order operations discontinued pursuant to the General Conditions, section 3.03 "Supervision of Work".

D. Special conditions imposed by the Project Specifications.

The above conditions may be modified by specific weather conditions or techniques proposed by the Contractor and acceptable to the Engineer. Such authorization for modification will be issued in writing.

The Construction Schedule shall list separately major items of work, whether pay items or incidental work.

2.00 EXCAVATION AND TRENCHING

2.01 EXCAVATION: Excavation shall include the clearing of the site for the work and the removal of all of the materials to a depth which is sufficient to permit the construction of the structure or installation of water main, sewer or drain lines in accordance with the plans. Excavated materials from trenches may be temporarily stored along the trench in a manner that will not cause damage to trees, shrubbery or other properties, and that will not endanger the banks of the trench by imposing too great of load thereon. Bituminous material or bituminous pavement removal shall be considered the same as earth excavation.

All excess excavation, fill, broken concrete, and other miscellaneous debris or other material generated by the project shall be hauled away the same day it is removed from the trench to a landfill approved by the Engineer. All required excavation and removal of excavated material from the project site shall be incidental to the Contract.

2.02 **EXCAVATION FOR STRUCTURES**: Excavation for structures will usually be stockpiled for use on the site. Topsoil, unless provided otherwise, shall be salvaged and stockpiled for spreading over the entire graded area. The dimensions of the excavation shall be sufficient for dewatering facilities and to provide adequate working area around the forms. During construction, the excavation shall be kept dewatered until concrete or mortar has attained initial set. Concrete shall not be poured under water without express written authorization of the Engineer. Excess excavation below grade of the structure's base shall be backfilled with 1,500 p.s.i. concrete.

2.03 **EXCAVATION BY TRENCHING TO GRADE**: The trench for water main, sewer or drain lines shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe barrel on solid and undisturbed ground. The Engineer may require excavation of the last 4 inches of depth to grade using hand tools.

If, in the opinion of the Engineer, soil conditions are encountered at subgrade which require all or part of this work to be done in accordance with section 2.05.A, the Engineer shall have the authority to order the work done. All excavation below ground shall be done to current MIOSHA guidelines and requirements.

2.04 **WIDTH AND LENGTH OF TRENCH**: The width of the trench shall be ample to permit the pipe to be laid and joined properly, and the backfill to be placed and compacted as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber support, sheeting and bracing, and dewatering facilities.

In order to limit excessive loads on the pipe, the maximum width of trench shall be 30 inches for pipe 6 inch to 10 inch inclusive. For pipe diameters 12 inch through 30 inch, the width shall not be more than 2 feet greater than the inside diameter of the pipe. For pipe over 30 inches in diameter, the trench width shall not be more than 2 feet greater than the outside diameter of the pipe. For elliptical pipe, trench width restrictions shall be determined by the pipe horizontal dimension in place. This limitation shall apply to the width of the trench at the top of the pipe.

On any run in public right-of-way, not more than 200 feet of open trench will be permitted at a time, unless pedestrian bridges are maintained at 200-foot intervals and one-lane (minimum) vehicular crossings are maintained at 300-foot intervals. Streets shall not be completely blocked without written permission from the Engineer.

2.05 **TRENCH EXCAVATION BELOW GRADE**:

A. Where called for on the plans or required by the Engineer because of soil conditions, the trench shall be excavated to at least 3 inches and not more than 6 inches below the specified grade in order to modify subgrade. Before the pipe is laid, the subgrade shall be prepared by backfilling with an approved material in 3-inch compacted layers. The layers shall be thoroughly tamped so as to provide a uniform and continuous bearing and support for the pipe barrel. Compaction shall not be less than 95 percent Standard Proctor Density.

B. For excavation greater than 6 inches below the specified grade, the Contractor shall remove the unsuitable material and replace same with an approved porous material, thoroughly compacted to 95 percent Standard Proctor density in 3-inch layers to the specified grade.

2.06 **SPECIAL FOUNDATION IN POOR SOIL**: Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Engineer, it cannot be removed or replaced with an approved material thoroughly compacted in place to support the pipe properly, the Contractor shall construct a foundation for the pipe, consisting of piling, timber or other materials in accordance with plans prepared by the Engineer.

2.07 **CLEARANCE IN ROCK**: Ledge rock, boulders and large stones shall be removed to provide the following clearances:

A. At least 6 inches below and on each side of all water pipe, valves and fittings for water service.

B. At least 3 inches below and a minimum of 12 inches on either side of the pipe and fittings for sanitary sewers and storm drains. The specified clearances are the minimum clear distances which will be permitted between any part of the pipe or appurtenances being laid and any part, point or projection of the rock.

2.08 **ROCK EXCAVATION**: The word "rock", wherever used as the name of an excavated material, shall mean boulders and pieces of concrete or masonry exceeding 2,000 pounds in weight, or solid ledge rock and masonry which in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, or breaking up with a power-operated tool. Pavements, soft disintegrated rock which can be removed with a handpick or power-operated excavator or shovel; loose, shaken or previously blasted rock or broken stone in rock fillings or elsewhere; and rock, exterior to the minimum limits of measurements allowed, which may fall into the excavation, will not be measured nor be allowed as an extra.

2.09 **BLASTING**: Blasting for excavation will be permitted only after securing the approval of the Engineer and only when proper precautions are taken for the protection of persons or property. The hours of blasting will be fixed by the Engineer. Any damage by blasting shall be repaired by the Contractor at his expense. The Contractor's methods of procedure in blasting shall conform to state and local regulations.

2.10 **REMOVAL & DISPOSAL OF CONTAMINATED EXCAVATED MATERIAL**: This item consists of removal and disposal of both Type 1 and Type 2 contaminated material if encountered during excavation. The City will be responsible for testing any suspected hazardous contaminated material. This item of work shall be paid per cubic yard, loose measure, which is removed and disposed of at a Type 1 or Type 2 approved landfill.

The contract unit price for this item shall include the cost of interruption to normal construction procedures, temporary stockpiling on plastic sheeting, placing and maintaining plastic sheeting over the stockpile, removal and disposal as directed by the City, and all related work and measures that may be required by law. Based on field screening and laboratory analysis by the City, the Contractor will be advised by the City as to the required method of disposal.

Under no circumstances shall this item include removal and disposal of contaminated material caused by or brought to the site by the Contractor.

2.11 **SHEETING, SHORING AND BRACING**: Where required to properly support the surfaces of the excavations to protect the construction work, adjacent work or workmen,

sheeting, bracing and shoring shall be provided, as required by current MIOSHA guidelines and requirements. If the Engineer is of the opinion that, at any point, sufficient or proper supports have not been provided, he may order additional supports at the expense of the Contractor. An approved pipe-laying box may be used in lieu of sheeting where safety or workmen is the sole consideration. Care shall be taken when the box is moved to avoid dislocation / loosening of pipe joints.

In removing the sheeting and bracing after the construction has been completed, special care shall be taken to prevent any collapse of the excavation and injury to the completed work or adjacent property.

The trench bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing. Sheeting, except that which has been ordered left in place, shall be removed as the backfilling progresses. Special care shall be taken to fill and compact voids created by removal of bracing and sheeting.

Where required to protect the work, adjacent structures or property, sheeting, shoring and bracing shall be left in place, but shall be cut off or left not less than 2 feet below the established surface grade.

2.12 **PUMPING, BAILING AND DRAINING**: The Contractor shall provide and maintain adequate pumping and drainage facilities for removal and disposal of water from trenches or other excavations. The Contractor shall provide pumping and drainage facilities for bulk-headed sewer sections and shall operate same until bulkheads have been removed or construction completed if bulkheads are to be left in place.

Where work is in ground containing free water, the Contractor shall provide, install, and maintain suitable drainage facilities such as well points connected to manifolds and reliable pumping equipment and shall so operate them to ensure proper working conditions. In impervious materials, the Contractor shall construct suitable drains, under-drains, sumps and provide adequate pumping facilities to maintain the trench in a dry condition. The Contractor shall take measures to protect pipe or structures from hydrostatic uplift. Drainage or discharge lines shall be connected to adjacent public sewers or extended to nearby water courses wherever possible. In any event, all pumping and drainage shall be done without damage to the roadway, receiving sewers, or other property. The Contractor shall ascertain the availability of adequate drainage for dewatering operations.

Gravel, stone or other material used in lieu of well points to drain water shall be considered an alternate method of dewatering or draining. Should the drainage contain sand, gravel, etc., which, in the opinion of the Engineer, should be kept from entering the sewer or water course, suitable sand traps shall be used.

2.13 **ABANDONING PIPES DURING EXCAVATION**: The Contractor shall install a one (1) foot thick water-tight masonry bulkhead in all piping determined to be abandoned by the Engineer. When directed by the Engineer, the abandoned pipe shall be abandoned by filling with flowable fill. Existing sewer leads that are not planned to be reconnected shall be abandoned within 12 inches of the mainline sewer tap. Install a cap (Qwik Cap, cap with Fernco, or approved alternate) and pour a 12-inch concrete collar around the capped stub.

2.14 ABANDONING MANHOLE OR GATE WELL

Abandon manholes or gate wells in accordance with the current MDOT standard specifications for construction, Section 203 except as modified herein. Work under this item shall include removing 4-to-6-foot diameter manholes or gate wells to a depth of 3 feet below existing grade at locations indicated on the plans or when directed by the engineer. The contractor shall remove and dispose of all debris within the structure as part of this work.

The contractor shall deliver all removed castings to the City of Royal Oak DPS yard at 1600 N. Campbell Road. All other material shall be hauled away and disposed of at a recognized landfill. This item of work shall also include installation of a 12 inch thick water-tight masonry bulkhead in the end of any pipe to be abandoned leading to the abandoned structure, filling-up the remaining abandoned structure with MDOT 6A stone, and backfilling the excavated area with sand in 12 inch layers compacted to 95 percent modified proctor density.

The sand shall conform to MDOT granular material Class II. When approved by the engineer, suitable excavated material of a granular nature may be utilized for the backfill.

2.15 **SOIL EROSION AND SEDIMENTATION CONTROL**: Soil erosion and sedimentation control shall be done in accordance with Public Act No. 451 of 1994 including all amendments. Permits from Oakland County Water Resources Commission (OCWRC) shall be obtained by the City, and the Contractor shall comply with all conditions of the permit. Soil erosion and sedimentation control measures including labor and materials shall be incidental to the Contract.

3.00 BACKFILLING

3.01 **GENERAL**: Backfilling includes the replacement and compaction of suitable material to restore site to grade. Compaction requirements shall be as specified. Flooding or any other method of compaction allowed by the Engineer shall not relieve the Contractor of the responsibility of the specified density requirements. Flooding the trench with water for compaction requirements shall not be allowed.

If there is a deficiency due to a rejection of unsatisfactory excavated material, the Contractor shall furnish the required amount of sand, gravel or other approved material as an extra.

3.02 **BACKFILLING AROUND PIPES**: From the bottom of the trench to 1 foot above the top of the pipe, the trench shall be backfilled by hand with sand, gravel or approved excavated materials and tamped in 3-9 inch layers, to 95 percent Standard Proctor Density. All sand or gravel backfill shall be incidental to the Contract.

At manholes, valve chambers, metering chambers and other points or rigid pipe support, special measures, including, if necessary, 2,500 p.s.i. concrete backfill, shall be provided to prevent shearing stress on the pipe line.

3.03 **BACKFILLING TO GRADE UNDER LAWN AREAS**: From 1 foot above the pipe to the original grade, the balance of trench may be backfilled by approved mechanical

methods. Fill shall be compacted in maximum 1 (one) foot layers by machine methods to 90 percent Standard Proctor Density.

Backfill material shall be free of cinders, ashes, refuse, sod, vegetated or other organic material, boulders, rocks or stones, pavement, or other materials which, in the opinion of the Engineer are unsuitable. The backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation.

3.04 **BACKFILL UNDER PERMANENT PAVEMENTS, DRIVEWAY SURFACES AND SIDEWALKS**: Where the excavation is made through permanent pavement, curb, driveway surfaces, sidewalks or where structures are undercut by the excavation, the backfill from 1 foot above the pipe to the subgrade shall be made with new sand or Engineer approved existing excavated sand compacted to 95 percent Standard Proctor Density. Fill shall be compacted in maximum 1 (one) foot layers by machine method. All sand backfill shall be incidental to the Contract, unless sand backfill is listed as an item in the Contract Form of Proposal.

3.05 **SPECIAL BACKFILLING REQUIREMENTS**: The Contractor will be required to comply with the regulations of state highway, county road, or railroad company with regard to backfilling and compaction in their respective rights-of-way; and shall be responsible for determining these regulations prior to bidding.

3.06 **BACKFILL AT STRUCTURES**: Backfill shall be placed against structures only after the structure has reached 75 percent of design strength. The backfill shall be compacted to 95 percent Standard Proctor Density. Backfill shall be placed in 8-inch layers and compacted with a hand or mechanical vibrator.

3.07 **COMPACTION TESTING**: The Engineer will perform all tests for compaction. The Contractor shall cooperate with the Engineer, furnishing such equipment and personnel as required. All density percentages shall be based on the Modified Proctor Method for compaction.

4.00 RESTORATION AND MAINTENANCE OF SURFACE PROPERTY OR STRUCTURES

4.01 **GENERAL**: Surface restoration shall include replacement of topsoil and seed, sod, shrubs and decorative plantings, signs, mailboxes, guard posts, gravel, walks, curbing shoulders, driveways and parking areas, alley and streets, castings, or other surface features existing prior to start of construction, as shown on the plans or directed by the Engineer.

4.02 **PAVEMENTS**: The term pavements shall include street, highway, parking lot, alley and driveway surfaces, and sidewalks.

Cuts through concrete pavement shall be at right angles to the pavement centerline. Removal of concrete pavement, either plain or reinforced, shall be done by cutting the pavement with powered, diamond blade saws or method approved by the Engineer. Opening shall be trimmed in straight lines with right angle corners and vertical edges. When pavement cuts are 5 feet or less from expansion or construction joints, the pavement shall be removed to the joints. The pavement shall be cut so that the pavement removal is 1(one) foot wider than the trench on each side. Sidewalks and curb, and curb and gutter, shall be removed to contraction or expansion joints.

Cuts through asphalt pavement may be made at any angle with the pavement centerline. Removal of asphalt pavements shall be done by cutting through the pavement with a powered saw or other approved cutting device. After cutting, asphalt may be removed with power equipment. Pavement shall be removed to expansion or contraction joints when the pavement cut is 5 feet or less from a joint.

Gravel replacement of streets, alleys, driveways, parking areas and walks shall include backfill, backfill compaction to 95 percent Modified Proctor Density, grading of the sub-base as well as placement, compaction and final shaping of an 8-inch compacted gravel surface. Shoulder area shall be stabilized with gravel to bear traffic, unless otherwise provided in the project specifications. Bituminous replacement shall include removal and disposal of the pavements and sub-base; placement and compaction of special backfill; placement, compaction and shaping of a 6-inch compacted gravel base; trimming of existing asphalt edges, priming of edges; and the placement and compaction of bituminous pavements to the thickness as directed by the Engineer.

Concrete replacement shall include sawing, breaking and removal, special backfill requirements for compaction, preparation of subgrade, all form work, expansion, contraction and load transfer joints, expansion anchors, furnishing, placing and curing the concrete. The pavement area shall be temporarily patched and maintained with 4" of compacted smooth cold patch (bituminous) or crushed concrete at the completion of each and every day if permanent pavement is not installed the same day. The permanent pavement replacement shall be completed within five (5) working days of completion of underground work or three (3) working days for pavement replacement projects, unless otherwise authorized by the Engineer.

No permanent pavement shall be restored unless and until, in the opinion of the Engineer, the condition of the backfill is such as to properly support the pavement. Pavement replacement shall follow as closely as practical to clean-up operations.

4.03 **TREES, SHRUBS AND LAWNS**: The Contractor shall remove only those trees and shrubs which are so designated on the plans, protecting all others from damage. When tree roots are removed because of trenching, the top of the trees shall be trimmed sufficiently to balance the loss of roots. This trimming shall be done by the Contractor under the direction of the Engineer. Any branches of trees damaged by equipment shall be neatly trimmed.

The Contractor is responsible for obtaining permission and instructions from the City of Royal Oak Department of Public Service (DPS) prior to trimming any trees. All trees 8 inches in diameter or less will require a tunnel for pipe installation 8 feet long. Trees over 8 inches in diameter, measured 4 feet above the ground surface, will require a tunnel length of one foot for each inch of tree diameter. Trees shall be tunneled or augured whenever any portion of an excavation approaches within a distance equal to one half of the required tunnel length. Tunneling shall be done with a boring machine; tunneling with a backhoe will **not** be permitted.

All vegetation which is in the construction operations(s) area shall be carefully protected from damage or injury during all construction work. The Contractor shall replace, at the Contractor's expense, all damaged, dead or dying trees or plantings, as directed by the Engineer, with equivalent size and species of the damaged vegetation.

The Contractor shall be responsible to restore all lawn areas disturbed in conjunction with the construction operations. Restoration of lawn areas on local streets shall be with minimum of 2 inches of topsoil and MDOT class A fertilized sod. The topsoil and sod shall be approved by the City prior to installation.

Restoration of lawn areas on major streets shall consist of minimum of 2 inches of topsoil, and seeding by means of hydro-seeding or placement of seed and mulch blanket. The seed shall be applied at a rate of 250 lb/acre evenly, and shall have the following composition of seeds:

30% Fults Pucinellia
30% Dawson Red Fescue
30% Park Kentucky Blue
10% Pennfine Perennial Rye, minimum purity 97%

This seed composition shall be certified by the supplier of the seed mixture. The Contractor shall be responsible to establish growth of lawn areas for a period of 90 days after sod is installed or 90 days after the lawn seed has germinated and has started to grow.

5.00 **BORING AND JACKING**: Where called for on the plans or in the Project Specifications, pipe of the size and type shown on the plans shall be placed by boring and jacking method as approved by the Engineer without disturbing the ground or pavement surface above the pipe. The tunnel shall be adequately sheeted or shored to prevent the sides and top from collapsing or the pavement from settling or cracking. Where possible, boring and jacking pits shall be at least ten (10) feet from the edge of the pavement. Direct boring of concrete tongue and groove pipe shall be Class V with joints as specified. The proper line and grade of the pipe shall be maintained. When jacking or tunneling pipe under railroad tracks, the face of the excavation shall be braced during passage of trains, at times when work is shut down, as directed by the railroad.

During boring operations, the auger shall not be advanced beyond the end of the casing. Casing pipe as shown on the plans is a minimum for the pipe being installed therein. The Contractor may at his option, elect to use larger casing pipe. Diameter, thickness and schedule of such alternate casing must be approved by the Engineer. The annular void between the casing and the carrier pipe shall be filled with cementitious grout as specified in current MDOT Standard Specifications for Construction, Section 402.03. Filler material is to be placed by an approved method which will provide a uniform and thorough filling of the void. The casing shall be filled to within 1 inch of the top +- 1/2 inch. Upon completion of the filling operation, the ends of the casing shall be sealed with a 1 foot thick bulkhead of 3500 p.s.i. grade concrete. When a casing pipe is not used, the cavity between the outside of the pipe and undisturbed ground shall be sealed at both ends of the bore with 2500 p.s.i. concrete a minimum of eight (8) inches thick.

6.00 METHOD OF MEASUREMENT AND BASIS OF PAYMENTS

6.01 **GENERAL**: The cost of work performed in excavating and backfill shall be included in the price quoted in the Proposal where the specific items of improvement are listed. Surface restoration, unless shown as a pay item in the Proposal, shall be considered as

incidental. Extra work such as sheeting left in place or rock excavation ordered will be paid for as provided in the Contract.

6.02 **EXISTING UNDERGROUND STRUCTURES AND UTILITIES**: When existing underground utilities require raising, lowering, or moving to another location, the City will be responsible for the cost thereof. Sheeting, bracing, or other means used to support a utility exposed or endangered by the Contractor's operations, is considered incidental. Relocating, raising, or lowering of a utility for the Contractor's convenience, repair of utilities damaged by the Contractor and related temporary services necessary because of extended periods of service outages are also considered incidental.

For buildings and structures, all existing utilities shown on plans and requiring removal and / or relocations are considered incidental to excavation for said buildings and structures.

6.03 **EXCAVATION**: Excavation to a depth of 6 inches below grade required by plans or by soil conditions is considered incidental. Additional excavation below this point, explained in sections 2.05 B (Excavation Below Grade) and 2.06, will be paid for as extra work. No compensation will be allowed for delays in the Contractor's schedule due to these conditions.

6.04 **SHEETING**: When sheeting and bracing have been ordered left in place, payment for same shall include the upper 2 feet of "cut-off" section of sheeting. Sheeting and bracing not left in place and the expense of using a sewer box are considered incidental.

6.05 **PUMPING, BAILING AND DRAINING**: The providing, maintaining or operating of any dewatering or drainage facilities are incidental and the cost thereof shall be included in the unit price bid for sewers, water mains, drains, or structures. Gravel, stone or other material used in lieu of well points or under drains to stabilize the trench will be considered an alternate method of dewatering, and therefore, an incidental expense.

6.06 **BACKFILL**: Removal and disposal of rejected backfill material from trenches (other than under pavements), and the furnishing and placing of an acceptable material, shall be considered as extra work. Measurement will be by truckload count, loose measure. Load tickets will be required and must be delivered to the inspector at the site. Removal and disposal of excess excavated material from trenches under pavements, driveway surfaces, and sidewalks and as defined under section 2.05 shall be considered incidental to the Contract.

Backfill and compaction around pipes, under pavements, and special backfill requirements, as defined under sections 2.05 A, 3.02, 3.04 and 3.05, are considered incidental to sewer, drain and / or water main construction and no extra payment will be allowed for this work, notwithstanding that sand backfill may be listed as an item in the Proposal.

6.07 **ROCK EXCAVATION**: Rock excavation will be measured by profiling the rock surface and computing minimum volume requiring removal to install the proposed facility. Payment shall be computed by cubic yard measure when listed as an item in the Proposal or as extra work, except that with building and structures, cost of rock is incidental when indicated on plans.

6.08 **PAVEMENTS**: Restoration of pavement will be measured by square yards and paid for under the Contract unit price.

Stabilization of shoulders is incidental. See section 6.01 of these specifications.

6.09 **BORING AND JACKING**: Boring and jacking including the casing pipe when required will be paid for on a linear foot basis. The price bid shall include the cost of required special permits, the jacking pit and shoring, labor, equipment and material required to install the pipe line and casing, backfill of the pit and cleanup, but shall not include the sewer or water main installed through the jacking area. Casing pipe size over minimum shown on plans will be considered incidental for Contractor's convenience.

6.10 **RAILROAD CROSSING**: Railroad inspection costs will be paid by the City, but all other costs and requirements are to be borne by the Contractor.

6.11 **BUILDINGS AND STRUCTURES**: Payment for work under this heading shall be on a lump sum basis. No claim for extra work will be considered unless ordered by the Engineer.

6.12 **CLEANUP**: Cleanup work is considered incidental to the item bid; however, failure to perform this work as required by the Engineer will be sufficient cause to withhold money for this work, or to order work on the project stopped until cleanup is accomplished under section 1.05.

GENERAL SPECIFICATIONS FOR SEWERS- SOIL EROSION CONTROL

1.00 SOIL EROSION

1.01 GENERAL: The Contractor shall obtain at his own expense any Soil Erosion and Sedimentation Control permit as may be required by the Oakland County Water Resources Commissioner (O.C.W.R.C.), unless otherwise indicated in the Contract. Refer to "General Conditions", section 5.04 of the City of Royal Oak Standard Specifications for Construction.

Under this work, the Contractor shall furnish all materials, labor, equipment and all else necessary for performing the installation and maintenance of required soil erosion control measures as required by the City and under a permit obtained from and issued by the Oakland County Water Resource Commission (WRC).

1.02 MATERIALS: The Contractor shall provide inlet filters, silt fencing, silt dikes, erosion eels, erosion blankets (mulch or woven), temporary stone access drives, and concrete washout stations where required by WRC.

1.03 PROCEDURE: The Contractor will be required to install soil erosion inlet filters at all catch basins and inlets within the project limits regardless of WRC requirements. All work and costs associated with soil erosion and sedimentation control shall be considered included with and part of the Contract.

Refer to the soil erosion details published by WRC for Low Point Inlet Filter (SI-2) and Low Point Inlet Filter Alt. "A" (SI-2A). Standard geotextile filter fabric shall not be considered an acceptable material for inlet filters. Contractors shall use a silt sack (Catch-All, Ultra-Urban Filters, Flogard Plus, or approved alternate) with built in overflow features.

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GENERAL SPECIFICATIONS FOR SEWERS

1.00 GENERAL

1.01 **SEWER LOCATION**: City sewers shall be located 10 feet clear horizontally and 1.5 feet clear vertically from all water mains. The Contractor is to notify the Engineering Division if either criteria cannot be met during the course of the work for approval of installation.

1.02 **DEFINITION**: As used herein, sewers shall be considered to mean all pipe or conduits and appurtenances intended to transport waste waters and / or storm waters and lying within City rights-of-way or easements.

1.03 **WORK INCLUDED**: The Contractor shall, unless otherwise noted in the project specifications, furnish all materials, equipment, tools, and labor necessary to do the work including all unloading, hauling, and distributing of materials required under this Contract. The Contractor shall also lay and test the sewer, clean up the site of the work, and maintain the street or other surface over the trench. Excavation and backfill shall be in accordance with the General Specifications for Excavating and Backfilling accompanying this document.

1.04 **LOCATION AND SCOPE**: The location and grade of the proposed sewers and the approximate depth at which they are to be laid is shown on the plans. An estimate of the quantity of work to be done is given in the Form of Proposal. The Engineer reserves the right to make minor changes in lines and grades of pipe line, locations of pipe and manholes, when such changes may be necessary or advantageous. Major changes will be made as prescribed in the General Conditions entitled "Changes in the Work".

1.05 **CLEAN-UP**: The sewer, manholes, inlets, services and appurtenances shall be cleared of all scaffolding, rubbish, dirt dams or other obstructions as work progresses. House services shall be installed as sewer laying progresses and within cleanup limitations unless otherwise provided. Clean-up work, including trench backfill and surface replacement shall follow pipe laying operations not to exceed 400 feet unless specific authorization is obtained from the Engineer.

1.06 **CERTIFICATION OF PIPE**: All pipe delivered to the jobsite shall be accompanied by certification papers showing that the pipe has been tested in accordance with the applicable specifications and that the pipe meets the specifications for this project.

1.07 **TESTS**: The presumptive tests, air testing, infiltration / exfiltration tests and television inspections will be done as specified hereinafter.

1.08 **SHOP DRAWINGS**: Furnish, as prescribed under the General Conditions, shop drawings of the items proposed under this section of the Contract. Design details of the joint shall be submitted to the Engineer for his consideration and approval before ordering any pipe.

2.00 MATERIALS – SEWERS

2.01 **GENERAL**: All materials furnished by the Contractor must conform in all respects to the following standard specifications. Where reference specifications are used, they shall be

considered as referring to the latest issue. Unless otherwise indicated, any material furnished by the Owner will also conform to these specifications.

ASTM F477	Joint Gaskets
ASTM D2680	ABS Truss Pipe
ASTM D2751	ABS Solid Plastic Pipe
ASTMD3034	PVC Solid Plastic
ASTM D2241	PVC Solid Plastic
ASTM F679	PVC Solid Plastic
ASTM C76	Reinforced Concrete Sewer Pipe (RCSP)
ASTM C655	Reinforced Concrete Sewer Pipe (RCSP)
ASTM C425	Clay Pipe Joints
ASTM C594	Clay Pipe Joints
AASHTO-M36	Corrugated Metal Pipe
ASTM C443	Joints in Concrete or Reinforced Concrete Pipe
ASTM C361	Joints in Concrete or Reinforced Concrete Pipe
AWWA C301	Joints in Concrete or Reinforced Concrete Pipe
AWWA C302	Joints in Concrete or Reinforced Concrete Pipe

2.02 **SEWER PIPE**: The locations of the various types of pipe are shown on the plans. Sanitary sewer pipe shall be designed for air testing.

All sewer pipe used in this work shall meet the requirements of the standard specifications of the National Clay Pipe Institute (NCPI), American Society for Testing and Materials (ASTM), or American Standards Association (ASA). Sewer pipe shall be of the following types as noted on the plans.

- PVC Solid Plastic Pipe – SDR26 (ASTM D3034) – for pipes 15” and smaller
- PVC Solid Plastic Pipe – PS 115 (ASTM F679) – for pipes 18” and larger
- Reinforced Concrete Pipe (RCP) - ASTM C76, class as designated on the drawings or special design conforming to ASTM C655
- ABS Truss Pipe
- ABS Solid Plastic Pipe - SDR 23.5

2.03 **JOINTS IN TRUSS PIPE:** Joints in ABS truss pipe shall be sleeve coupling type "SC" chemically welded joint as specified in ASTM Standard D2680. Gaskets (elastomeric seals) shall meet the requirements of ASTM Designation F477.

2.04 **JOINTS IN CONCRETE OR REINFORCED CONCRETE SEWER PIPE**: As follows:

A. Sanitary Sewers - Joints in concrete sewer pipe for sanitary sewers shall be bell and spigot or tongue and groove, ASTM or AWWA concrete, with rubber gasket, or equal.

Modified groove tongue concrete pipe shall have a compression type rubber gasket snapped into a groove cast into the tongue. The modified groove or bell end of the pipe shall be made smooth and shall have not over a three (3) degree slope tapered to fit the rubber gasket to tolerances as detailed by the gasket manufacturer.

Rubber gaskets shall meet the physical requirements of ASTM.

Lubricant shall be supplied by the manufacturer to be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirements.

B. Storm Sewers - Joints in concrete or reinforced concrete sewer pipe for storm sewers 30 inches in diameter or smaller shall be bell and spigot or tongue and groove, ASTM or AWWA, with compression type rubber gasket or approved equal.

Lubricant shall be supplied by the pipe manufacturer and the joint shall be coupled in accordance with the manufacturer's instructions.

Rubber gaskets shall be supplied by the pipe manufacturer and the joint shall be coupled in accordance with the manufacturer's instructions.

Rubber gaskets shall meet the physical requirements of ASTM.

2.05 **CEMENT MORTAR JOINTS**: Cement mortar joints shall consist of one part cement and two parts sand.

A. Cement - Portland cement shall conform to the requirements of ASTM Type 1, C-150.

B. Masonry sand shall conform to the requirements of masonry sand in Section 902 of the MDOT Standard Specifications for Construction.

C. Water used in mixing cement mortar shall be fresh and clean and free from injurious amounts of oil, acid, alkali, organize matter or other deleterious substances.

D. Jute - Best quality Manila yard, closely twisted, in one piece for each joint and of proper size to fit the barrel dimensions.

2.06 **DIE-CAST BITUMINOUS JOINTS**: Die cast, tapered joints, pre-cast onto the pipe, shall be made by fitting the bell and spigot end of the pipe with collars of bituminous compound having a melting point of 240^{o}F and penetration of 4.7 at 77^{o}F.
The ring of bituminous compound shall be die-cast into the bell of the pipe and around the spigot of the pipe of such size and dimension that when the spigot is shoved firmly into the bell, a tight fit between the bell and the spigot will be made and the inverts will be in alignment.

Primer material for jointing die-cast bituminous joints shall, when applied to the joint surfaces, cause the surface to become plastic. When the pipes are shoved firmly together, the joint material shall unify with diffusion of the solvent, congeal, and become one homogenous body.

2.07 **COLD MASTIC JOINT COMPOUND**: Sewer joint trowel compound shall consist of bituminous compounds which, when installed, shall provide a joint which will withstand 10 feet of static head. Both the bells and spigots of the pipe shall be primed with priming material as manufactured specifically for the joint material supplied. Material shall conform to Federal Spec. SS-S-00201 or shall be pre-molded plastic.

2.08 **RUBBER JOINTS ON CONCRETE PIPE**: Joints shall meet all requirements of ASTM C-443-05 modified to include "O" rings on grooved pipe ends. Type of joint and the jointing materials proposed to be used by the Contractor together with reference to similar installation shall be submitted to the Engineer for approval. Solvents, adhesives and/or lubricants used shall conform to the Manufacturer's recommendations.

2.09 **PREMIUM JOINTS ON CLAY PIPE**: Joint material pre-cast on the pipe spigots and in the pipe bells shall meet requirements of ASTM C-425, Type I, II or III.

2.10 **RUBBER GASKETED JOINTS FOR PVC SDR26**: Joints for P.V.C. pipe shall be bell-and-spigot type rubber gasketed joints conforming to the requirements of ASTM F477.

3.00 RESPONSIBILITY FOR MATERIALS

3.01 **MATERIAL FURNISHED BY THE CONTRACTOR**: The Contractor shall be responsible for all material furnished by him and shall replace, at his own expense, all such material found defective during the life of the Contract

3.02 **MATERIAL FURNISHED BY THE OWNER**: The Contractor's responsibility for materials furnished by the Owner shall begin at the point of delivery thereof to the Contractor. Materials already on the site shall become the Contractor's responsibility on the day of award of Contract.

The Contractor shall examine all materials furnished by the Owner at the time and place of delivery to him and shall reject all defective material. Any material furnished by the Owner and installed by the Contractor without discovery of such defect will, if found defective prior to final acceptance of the work, be replaced with sound material furnished by the Owner. The Contractor, however, shall at his own expense, furnish all supplies, labor, and facilities necessary to remove such defective material and install sound material in a manner satisfactory to the Engineer.

3.03 **STORAGE**: The Contractor shall be responsible for the safe storage of all materials furnished by or to him and intended for his work. Pre-jointed pipe shall be stacked or strung to prevent bearing on the spigot end, or any other damage to the exposed joint material. The Contractor shall not store or place materials on private property. The Contractor shall not store or place materials in City parks without obtaining written permission from the Engineer.

3.04 **DISPOSITION OF DEFECTIVE MATERIALS**: Any material found during the progress of the work to have cracks, flaws or other defects, will be rejected by the Engineer. All defective material furnished by the Contractor shall be promptly removed by him from the site. Any material furnished by the Owner and found defective shall be set aside by the Contractor and removed from the site by the Owner.

4.00 LINE AND GRADE

4.01 **STAKES BY CONTRACTOR**: The Contractor will furnish all line and grade control unless otherwise specified in Contract documents. Re-staking required by changes or delay in Contractor's schedule shall be paid for by the Contractor. The Contractor shall provide the Engineer with three (3) copies of a cut sheet for all staked or marked points before the work referenced by the cut sheet commences.

4.02 **LINE AND GRADE CONTROL**: As follows:

A. Laser Alignment - The Contractor shall furnish all necessary equipment and personnel required to operate the laser equipment.

The laser beam projection is to be rigidly mounted to its support platform in a manner to be approved by the Engineer. This will assure that all ground equipment

vibrations will be kept to a minimum and will permit the laser beam to be projected coaxially through the center of the pipe. All units shall be furnished with equipment to control atmospheric conditions in the pipe which could affect the acceptable standard of construction.

The laser aligning method selected must be shown to have performed satisfactorily on at least three previous projects of a similar nature. The equipment shall be operated by competent, trained operators.

The Engineer will establish centerline stakes and offset stakes at each manhole and other centerline and offset stakes as required for check points.

The Contractor shall furnish openings in the pipe, as required for the installation of the laser equipment, at no additional cost to the Owner. Details of these openings shall be approved by the Engineer.

B. Allowable Tolerances in Sewer Grade - Sewers shall be constructed and laid to the alignment and grade indicated on the plans or as designated by the Engineer. The grade as shown on the profile or as furnished by the Engineer is that to which the work must conform. A variation of one-quarter (1/4) inch from this will be deemed sufficient reason to cause the work to be rejected and re-laid.

C. Deviation from the above specified method of obtaining line and grade will not be permitted unless the deviation has been approved in writing by the Engineer.

5.00 LAYING

5.01 **INSPECTION**: If the Contractor wishes to lay pipe at more than one location on a given day, or work more than one pipe-laying crew, he must notify the Engineer at least two days in advance so that an adequate number of inspectors can be assigned to the job. Pipe laid in absence of an inspector shall not be accepted.

5.02 **HANDLING**: Pipe shall be protected during handling against impacts, shocks and free fall. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. Pipe shall be carefully lowered into the trench in such a way as to avoid danger to the workmen, or damage to the pipe, work completed, or existing utilities.

5.03 **DIRECTION OF LAYING**: Work shall start at the lower end of the sewer system and proceed up-grade with the individual pipes being laid with the spigot or tongue end downstream.

5.04 **BEDDING**: As follows:

A. Trench - Pipe shall be laid with a firm and even bearing the full length of the barrel, with a small additional excavation being made below grade under the bell in cases where bell and spigot type pipe is being used. See page SD-2 entitled "Methods of Laying Sewer Pipe".

B. Encasements - Sewers within encasements shall be secured true to line and grade by thoroughly and completely bedding in sand, fine gravel or a lean grout, blown or pumped in place.

5.05 **PLACING**: All pipe shall be laid with joints fully made and true to line and grade. Successive pipes shall be carefully centered so that when laid they form a sewer with a

uniform slope. Each pipe shall be held firmly in place against the previous pipe while the joint is being made and fixed in place by immediate bedding of the pipe to 1 foot above top of pipe. On tongue and groove pipe, 30 inches in diameter and larger, pressure must be applied to each pipe as it is laid by a winch and cable or other mechanical means to ensure that the spigot is all the way home in the socket. Care shall be exercised to prevent joints on pipe from opening up as subsequent lengths of pipe are laid.

The Contractor will be required to leave joints of the type specified smooth and clean. The pipe layers shall inspect each joint after it is made to see that the joint is properly pulled home and that no part of the joint material is left on the inside of the pipe.

No pipe shall be laid upon a foundation in which frost is present. Under no conditions shall pipe be laid in or under water. The trench shall be kept free of water during the jointing and, if necessary, for a sufficient period thereafter to allow the jointing material to become fully set and completely resistant to water penetration or damage.

5.06 **SPECIAL SUPPORTS**: Where sewer pipe, including services, cross existing pipe lines in close proximity as defined below, both pipes shall be saddled with concrete.

- Between water and sewer pipeline – less than 18-inch clearance between pipes
- Other utilities – less than 12-inch clearance between pipes

Utilities crossing the trench shall be temporarily supported during pipe laying operations, and permanently supported on compacted backfill.

5.07 **PIPE KEPT CLEAN**: The interior of the sewer shall be cleared of all jointing material, dirt and material of any description as the work progresses. On small sewers where cleaning after laying may be difficult, a swab or drag shall be kept in the pipe line and pulled forward past each joint immediately after its completion.

6.00 PIPE JOINTS

6.01 **CEMENT MORTAR JOINTS**: Mortar shall be applied only to thoroughly moistened pipe bells, spigots, tongues, and grooves.

On bell and spigot pipe, plastic mortar shall be spread in the bottom one-third of the bell of the pipe previously laid. A coarsely twisted gasket of jute of the proper thickness and of sufficient length to span around the pipe at the top shall then be wrapped around the spigot end of the next pipe, the pipe entered into the bell and shoved home. After the pipe has been thoroughly bedded to line and grade, the jute gasket shall be caulked into the annular space with a suitable caulking tool. The remainder of the space shall then be filled with mortar and beveled off. Joints on pipes 24 inches and larger in diameter shall also be pointed and smoothed from the inside.

On tongue and groove type pipe, the mortar shall be placed on the outside upper half of the tongue of the pipe to be laid on the lower half of the groove of the pipe previously laid. The pipe shall then be forced home, aligned and graded. Sufficient mortar shall be placed on each pipe to fill the joint when the pipe is forced into place. Joints on pipe 24 inches or larger in diameter shall also be pointed up from the inside. Visible voids on the outside of the joints shall also be filled with mortar, troweled into place. Excess mortar shall be removed from the inside of joints, regardless of size of pipe.

6.02 **COLD MASTIC JOINTS**: The cold mastic shall be troweled into the primed tongue end of the pipe while the pipe is on the bank. Jute shall be used to center bell and spigot pipe, as specified for mortar joints. Care shall be taken in lowering the pipe into the trench to keep dirt and stones out of the mastic. The pipe shall be brought firmly home, aligned and graded.

6.03 **RUBBER GASKET JOINTS**: The gasket or spigot shall be fitted over or glued onto the outer end of the tongue of each pipe to be laid and the pipe pushed home. The "O" rings shall be checked for correct position in the pipe groove. Solvents, adhesives and / or lubricants shall be used as recommended by the joint manufacturer.

6.04 **PREMIUM JOINTS**: Premium joints shall be painted with manufacturer's approved lubricant or solvent and the joint fully made. If difficulty is encountered in seating, the joint shall be disassembled and carefully inspected for obstructions and proper dimensions. Type III joints shall be checked after assembly for proper gasket position.

6.05 **CORRUGATED METAL PIPE JOINTS**: Corrugated metal pipe joints shall be made by carefully matching the pipe and collar corrugations, with the collar centered on joint. The neoprene gasket shall be lubricated to prevent binding or bunching up. The collar shall be carefully and evenly tightened to fully engage the pipe corrugations. If deflection of joints is required, joints shall be made prior to deflecting the pipe to plan alignment.

7.00 CONNECTIONS

7.01 **EXISTING SEWERS**: Where a manhole exists at the point of connection of new and existing sewers, it shall be re-pointed and any loose bricks and / or blocks in the walls of the existing manhole shall be re-laid. The cost of such work shall be included in the contract price unless payments are specifically provided in the Proposal.

Connections of new sewers to existing sewers when encountered in construction and not shown on the plans shall be made where ordered by the Engineer. Such connections shall be made within a manhole except for house service and drain connections. When such sewer connections are made within an existing manhole, any added work involved will be paid for in accordance with the procedure outlined in the "General Conditions".

When connections are made with sewers carrying sewage or water, a flume or dam must be installed and pumping maintained as necessary to keep the new work dry until the joints and the concrete have had sufficient time to set.

7.02 **FUTURE SEWERS**: Connections for future sewer stubs indicated on the plans shall be plugged or bricked off at the ends, the cost to be included in the contract price for the manholes or sewers. The ends of such future connections in sizes 4 through 21 inches shall be sealed with an appropriately sized disc and with the same type of jointing materials used on the new sewers. For sewers 24 inches and larger, the end of the sewer shall be bricked off and plastered on the outside.

7.03 **SERVICES**: Wyes or tees for house service connections shall be placed at locations indicated in the field by the Engineer.

All house service connection openings shall be "Y" branches with the spur set on the barrel of the pipe at an angle of 45º for pipe sizes to 24 inches. Tees or wyes may be used for pipe 24 inches and larger. Service connection openings in concrete pipe shall be cast in the upper quarter of the pipe with spur having standard bell dimensions for the service connection. Joint type and material for the services shall be the same as specified for the sewer. The ends of house service shall be closed with standard plugs or caps securely blocked to resist test pressure and sealed with the same jointing material used on the service pipe.

Where the sewer has over 12 feet of cover, risers shall be constructed as shown on page SD-4 of these specifications.

The location of each house service connection at the lot line shall be marked by a 2 inch by 2 inch wooden stake which shall have at its lower end a piece of 2 inch by 6 inch lumber, 12 inches long nailed horizontally. In lawn or paved areas, the stake shall be cut off 4 inches below grade and in undeveloped areas, the stake shall be cut off 6 inches above grade. Wyes or tees plugged for future service connections shall not require markers. The Contractor shall assist the Engineer in locating and keeping a record of all wye and / or tee openings left for service connections by measurement to the nearest downstream manhole, and the ends of services by measurements from permanent surface witness points.

House services shall be laid at right angles to the street line unless otherwise directed and shall be laid on a uniform line and grade from the sewer opening to the property line unless otherwise specified. The minimum depth at the property line shall be 8 feet below the approved street grade centerline. Where this depth cannot be obtained, the house connections shall be laid with a minimum rise of 1/8 inch per foot between the sewer and the property line.

7.04 **CONNECTION TO EXISTING SEWERS**: Any connections between new pipe and existing lines up to 15 inches in diameter shall be the compression coupling type with bushings as supplied by the manufacturer, meeting the requirements of ASTM Standards. Adjustable rings shall be required in all couplings 6 inches or larger. Clamps and shear rings shall be stainless steel. The following types of pipe couplings are approved for this work:

A. Logan LCP Coupling

B. Fernco Series 1002 RC, 1006 RC, 5000 RC, or 6000 RC (Strong Back RC Couplings)

Joint requirements for replacement pipe connection to existing pipe greater than 18 inches in diameter:

A. Clay/concrete to clay/concrete: Cadillac wrap or Fernco POW-R wrap and concrete collar.

B. Plastic to clay/concrete: Fernco Strong Back RC couplings.

7.05 **CONNECTIONS TO EXISTING MANHOLES**: The Contractor shall furnish all labor and materials required for the connection of sewers and catch basin leads under the Contract to existing manholes, structures and catch basins as called for on the plans. When breaking holes for connections to existing manholes or catch basins, care shall be

taken to prevent debris from entering the existing sewers or leads. After installation of pipe, the manhole or catch basin shall be pointed up around the pipe, both on the inside and outside of the manhole or catch basin, so that it is restored to a watertight condition. New flow channels shall be installed in the existing manholes where called for on the drawings. The cost of this work shall be included in the unit price bid for sewers and / or catch basin leads.

7.06 **PRIVATE SEWER LATERAL TAP ON EXISTING SEWER**: All new service connections shall be made with a saddle fitting where the service lead meets the main sewer. The exterior pipe surface shall be properly cleaned of debris and materials so that a clean cut may be made with a tapping or coring machine. Do not tap near a joint. Tap all the way through the pipe and remove the disk carefully. Install the saddle fitting at the prepared service hole and inspect for tight fit. Properly seal the service connection pipe to the main line sewer by using one of several multi-grout or epoxy resin mixes approved by the Engineer. Backfill the service lead connection and service lead footage properly in order to provide strong support and minimize shifting or breakage of the service connection. A Kor-N-Tee pipe to pipe connector may be allowed to be used to tap sewers 24 inches or larger in diameter with a minimum of 2.5 inches of wall thickness.

7.07 **PRIVATE SEWER LATERAL TAP ON EXISTING MAIN LINED SEWER (CIPP)**: After a main pipe has been interior lined with a cast in place piping (CIPP) and placed in service, all new service connections shall be made with a saddle fitting where the service lead meets the main sewer. The old exterior pipe surface shall be properly cleaned of debris and materials so that a clean cut may be made with a tapping or coring machine. Do not tap near a joint. Make the cut all the way through the old pipe and the interior CIPP layer to the actual interior of the main line sewer. Remove the cut out portion carefully. Inspect the cut and trim carefully so the CIPP and old existing pipe thicknesses line up properly. Do not use hammers or other devices to break out the old pipe away from the CIPP.

Install the saddle fitting at the prepared service hole and inspect for tight fit. Properly seal the service connection pipe to the main line sewer by using a multi-grout or epoxy resin mix approved by the Engineer. Backfill the service lead connection and service lead footage properly in order to provide strong support and minimize shifting or breakage of the service connection.

8.00 **TESTING**: All tests shall be under the supervision of the Engineer. Prior to connecting any active sewer services or extending services beyond the property line, the new sewers and services shall be tested for alignment and leakage. The sewer shall be thoroughly cleaned in accordance with the General Specification for Sewer Cleaning before the Engineer is requested to witness or perform any tests.

8.01 **ALIGNMENT**: Sewers must be straight between manholes and will be tested for straightness by flashing a light from manhole to manhole or by other suitable means.

8.02 **LEAKAGE**: Unless otherwise called for in the project specifications, the maximum allowable infiltration / exfiltration shall be 100 gallons per day per inch of diameter per mile of pipe. The joints shall be tight and any visible leakage in the joints and leakage in excess of that specified shall be repaired.

Branch fittings and ends of house service stubs shall be securely plugged to withstand test pressure. The section of line being tested shall also be securely plugged as required. All plugs shall be adequately braced.

No section tested may show a leakage of over twice the allowable limit and the average leakage for the project shall not exceed the allowable limit. All manholes will be inspected for visible leakage and the Contractor shall make all necessary repairs.

A. Water Testing - The Contractor shall furnish, install, and maintain a "V" notch weir, tightly secured to the low end of each section of sewer, so that the infiltration may be checked. The Contractor shall remove the weirs and all framing, leaving the sewers and manholes clean and free of any debris.

   Exfiltration tests will be required only when the natural or induced ground water table is less than 2 feet over the highest point in the pipeline under test, including house services. Exfiltration tests shall be made by filling the line to a minimum depth of 2 feet above the high point of the line under tests, with allowance for ground water level, and measuring the water required to maintain this level.

B. Low Pressure Air Testing - The Contractor shall furnish all equipment and personnel to conduct an acceptance test using low pressure air.

   Air shall be slowly supplied to the plugged pipe line until the internal air pressure reaches 4.0 pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

   The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 to 2.5 pounds per square inch.

   The pipe line shall be considered acceptable if the time interval for the 1.0 psi pressure drop is not less than the holding time listed in the following air test table from ASTM C828:

Nominal Pipe Size (in)	Time (min/100ft)
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3
24	3.6
27	4.2
30	4.8
33	5.4
36	6
39	6.6
42	7.3
48	8.5

Note: To be used when testing one diameter only

8.03 **TELEVISION INSPECTION**: All sewer sections in which spot repairs are made shall be internally inspected by televising upon completion of the work.

The Contractor shall furnish all materials, labor, equipment and all else necessary for performing a television inspection of new sanitary sewers. Any necessary cleaning and pumping of sewage is also included.

The inspection shall be carried out under the direct supervision of the Engineer's representative with all television inspection being observed by the Engineer.

All television inspection shall be recorded in a digital color video format which shall be turned over to the Owner. The recording must be continuous with audio commentary.

The inspection shall involve the visual observation by closed circuit television. The inspection shall be performed at a rate of speed and sufficient lighting which will allow examination of all points of infiltration, cracked or crushed pipe, defective joints, misalignment in line or grade, location of wye openings and any defects which may appear. Any items which, in the opinion of the Engineer, require repair shall be precisely located and described by a detailed statement of the condition.

As part of the television inspection, the precise location of each wye shall be noted in relation to manholes. These locations shall be entered on the wye location sheet supplied by the Contractor.

If the camera encounters a dip in the sewer such that water is standing above the springline of the sewer pipe, and if the camera lens becomes submerged because of this condition, the camera rig shall be withdrawn from the sewer and inserted from the other end as far as possible. At all times, backflooding into the reach from the adjacent section shall be prevented.

Two copies of all inspection videos, field reports, notes, wye locations, and other pertinent information made as part of the television inspection must be furnished to the Engineer stored on USB flash drives, portable external hard drives, or other approved media storage devices. One set of this information shall be turned over to the Engineer upon the completion of the inspection of each line. The second copy of the information shall be held by the Contractor until completion of the project, at which time it shall be neatly assembled and turned over to the Engineer.

9.00 MANHOLES AND CATCH BASINS

9.01 **DESCRIPTION OF WORK**: Work included shall consist of the furnishing and construction of manholes and catch basins including inlets as detailed on the drawings and at the locations shown on the drawings. Concrete, excavation and backfill shall be as specified herein before. Manholes and catch basins shall be complete with frames, covers and steps, unless otherwise addressed in Form of Proposal. Adjustment of frames, inlets, etc., in new manholes and catch basins to meet new or existing pavement surfaces of sidewalks shall be included in the work under this section of the Contract.

9.02 **QUALITY ASSURANCE**: As follows:

A. All materials furnished by the Contractor must conform in all respects to the following standard specifications. Where reference specifications are used, they shall consider as referring to the latest edition. Unless otherwise indicated, any material furnished by the Owner will also conform to these specifications.

ASTM A48	Cast Iron
ASTM C478	Precast Reinforced Concrete
ASTM C443	Joints
ASTM C923	Resilient Connectors
ASTM C55	Concrete Brick (Grade N)
ASTM C139	Concrete Block
ASTM C76	Concrete Pipe Reinforcement

B. Certification of Materials -
All pre-cast concrete manhole sections, resilient connectors between manhole sections and pipes and castings delivered to the jobsite shall be preceded or accompanied by certification papers or stamped markings showing that the materials have been tested in accordance with applicable standard testing procedures and that the materials meet the Specifications for this Contract.

9.03 **SUBMITTALS**: Shop Drawings and Guarantees - Furnish, as prescribed under General Conditions, shop drawings and guarantees of the items included under this section of the Contract.

Shop drawings shall include dimensions and reinforcement of pre-cast concrete units, joint details, orientation and elevation of preformed openings in riser sections, pipe to manhole connection details, casting details, and certification papers.

9.04 **MANHOLE MATERIALS**: Manholes on new sanitary sewers of 48 inches diameter and smaller shall be pre-cast reinforced concrete with flexible watertight connections between the manhole wall and the sewer pipe.

Manholes on new sanitary sewers larger than 48 inches in diameter shall be pre-cast reinforced concrete set on integrally cast pipe tee sections. Pipe reinforcement shall meet ASTM specification with class as indicated on the drawings for the adjoining pipe. Vertical risers shall be set on the tangent of the horizontal pipe. As an alternate, manholes may be constructed according to details shown on the drawings.

Manholes on existing sanitary sewers shall be pre-cast reinforced concrete with preformed arched openings and the sewer pipe grouted into the opening and made watertight.

Manholes on new or existing storm sewers, water mains and pumping mains, shall be pre-cast reinforced concrete or of concrete block or concrete brick unless otherwise noted on the drawings.

Manhole slabs shall be constructed of concrete and manhole channels and fillets shall be constructed of concrete according to the details given on the drawings. Unless otherwise directed, all surfaces of concrete channels and filets shall be screed and floated to a smooth, uniform surface and trowel to a hard finish.

9.05 **MANHOLE STEPS**: Manhole steps shall be steel reinforced high density polypropylene plastic. They shall be a minimum 10 inches wide and placed a maximum of 16 inches apart. Steel reinforced plastic steps shall be PS1-B or PS2-PFS as manufactured by M.A. Industries, Inc., or equal.

9.06 **CEMENT MORTAR JOINTS**: Joints shall consist of one part cement and two parts of sand.

A. Cement - Portland cement shall conform to the requirements of ASTM Type 1, C-150. Masonry Sand shall conform to the requirements of Masonry Sand in section 901 of the current MDOT Standard Specifications for Construction.

B. Water used in mixing cement mortar shall be fresh and clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

9.07 **FRAMES AND COVERS**: Cast iron frames and covers shall be furnished and placed on each manhole by the Contractor. Castings shall meet the requirements of ASTM, and shall be of the size and type as called for on the drawings. On all sanitary or combined sewer manholes, lids shall be self-sealing type. Castings shall be set flush with sidewalk, pavement or ground surface and shall be securely cemented in place.

Where noted on the drawings, bolted gasketed frames and covers shall be provided. The frames shall be anchored to the concrete manhole sections according to details shown on the drawings.

Install 1045 frames for manholes and catch basins.

Drainage Structure Covers:

STRUCTURE	CASTING
Gate Well	E.J. 1040 w/ "WATER SUPPLY" Cover with Royal Oak logo (EJ Part # 001040185)
Sanitary or Combined Manhole	E.J. 1040 w/ "SANITARY SEWER" Type AGS Solid Cover with Royal Oak logo (EJ Part # 001040183)
Storm Manhole	E.J. 1040 w/ "STORM SEWER" Type C 2 Hole Vent Cover with Royal Oak logo (EJ Part # 001040184)
Catch Basins & Inlets within Lawn Areas	E.J. 1040 w/Type N Oval Grate (EJ Part # 00104042) or Type 02 Beehive Grate (EJ Part # 00104044)
Catch Basins & Inlets within Pavement or Gutter	E.J. 1040 w/Type M Grate or Type #100199 Grate with either 2 slots (EJ Part # 001040186) or 4 slots (EJ Part # 001040399)
Catch Basin & Inlets within Curb & Gutter	E.J. 7045 w/Type M1 Grate (if full height curb) (EJ Part # 00704500) E.J. 7065 w/Type M1 Grate (if drop curb) (EJ Part # 00706500)

9.08 DROP CONNECTIONS: Where shown on the drawings, directed by the Engineer or where a sanitary branch sewer is brought into a manhole more than 24 inches above the invert elevation in the manhole, an internal drop connection shall be provided according to the details shown on the drawings. No drop connections shall be installed outside the manhole unless approved by the Engineer.

9.09 PRECAST REINFORCED CONCRETE MANHOLES: As follows:

A. Joints - Premium modified tongue and groove joints with rubber gaskets meeting the requirements of ASTM shall be provided for all sanitary sewer manholes. Joints in storm sewer, water main and pumping main manholes shall be either premium joint as specified for sanitary manholes or shall be tongue and groove with a cold-applied plastic joint-sealing compound and primer.

The joints around the inside circumference of the manhole shall be pointed with cement mortar. All holes provided for handling and lifting shall be filled with mortar and made watertight.

B. Foundations with Channels - Foundations including channels for pre-cast manholes shall be constructed as a cast-in-place concrete slab, pre-cast reinforced concrete slab, or pre-cast reinforced concrete base riser section with integral floor as shown on the drawings. Steel reinforcing for pre-cast base slabs shall meet the requirements of ASTM.

C. Pipe to Manhole Connections - Pipe to manhole connections on new sanitary sewers shall be made with resilient connectors meeting the requirements of ASTM and shall be adequate for hydrostatic pressures of 10 psi, without leakage, when tested in accordance with ASTM Specifications.

9.10 MASONRY MANHOLES (STORM SEWERS ONLY): As follows:

A. Foundations - Foundations shall be constructed as cast-in-place concrete slab, or pre-cast reinforced concrete base slab as shown on the drawings.

B. Masonry - Masonry units for manholes shall be either concrete brick or concrete manhole blocks, and shall meet the requirements of the standard specifications of the American Society of Testing Materials.

C. Laying Brick - All brick shall be clean and shall be thoroughly wetted by immersion, when practical to do so, just before laying. If immersion is impractical, brick shall be thoroughly sprinkled just before laying. All brick and block shall be laid in a full bed of mortar, without requiring subsequent grouting, flushing, or fillings, and shall be thoroughly bonded. Bricks shall be laid with long dimensions radially in the manhole and all joints must be entirely filled with mortar. Each 7^{th} course shall be laid as a "stretcher" course. The outside surface of each manhole shall be plastered with mortar to a depth of not less than 1/2 inch.

D. Laying Concrete Manhole Blocks - All blocks shall be clean and shall be laid in full bed of mortar, in courses with full and close mortar joints. The courses shall be level throughout, except where otherwise specified. Adjoining courses shall break joints

by one-half the length of the block as nearly as practicable. The outside surface of each manhole shall be plastered with mortar to a depth of not less than 1/2 inch.

E. Cement Mortar - Mortar for laying masonry work in manholes and other appurtenances shall be mixed in the proportion of one (1) part Portland cement to three (3) parts sands. Hydrated lime may be added in proportions not to exceed 10% of the volume of the cement.

F. Mortars mixed by hand shall be prepared in a suitable, clean, watertight box. The ingredients, except the water, shall first be thoroughly mixed dry until of uniform color; then water shall be added and the mixing continued until mortar is of proper consistency and uniform texture is produced.

No re-tempered mortar or mortar that has been mixed for more than 30 minutes shall be used in the work. No cement mortar shall be mixed when the ambient temperature is below 30^{o}F without properly heating the sand and water.

G. Backfilling - No backfilling shall be placed about masonry manhole walls within 12 hours after the plaster coat has been applied to the outside of the walls.

9.11 **CATCH BASIN MATERIALS**: Catch basins shall be constructed of pre-cast reinforced concrete units or masonry. These pre-cast units shall conform to the requirements of ASTM. Inside grouting with either cold-applied, ready-to-use plastic joint-sealing compound or rubber gasket shall be used to connect the units. The use of concrete manhole block conforming to ASTM as an alternate will be permitted. If block is used, a mortar coating shall be applied the same as with masonry construction of manholes. Catch basins shall be constructed with two (2) foot deep sumps.

9.12 **CATCH BASIN BACKFILLING**: No backfilling shall be placed about masonry structure walls within 12 hours after the plaster coat has been applied to the outside of the walls.

9.13 **CATCH BASIN FOUNDATIONS**: Foundations shall be constructed as a cast-in-place concrete slab according to details given on the drawings or pre-cast reinforced concrete base slabs as specified under manholes.

9.14 **CATCH BASIN FRAMES AND COVERS**: Frames and covers shall be as noted on the drawings and meet the Owner's standards. Castings shall be set flush with sidewalk, pavement or ground surface and shall be securely cemented in place. Elevations of castings shall be established as addressed in the Contract documents at the time of construction. Refer to Section 9.07 on page S-14 of these specifications.

9.15 **CATCH BASIN STEPS**: Catch basin steps shall be furnished and installed in catch basins if shown on the drawings. Steps shall be steel reinforced high density polypropylene plastic. They shall be a minimum of 10 inches wide and placed a maximum of 16 inches apart. Steel reinforced plastic steps shall be PS1-B or PS2-PFS as manufactured by M.A. Industries, Inc., or equal.

9.16 **TRAPS**: Storm manholes immediately upstream of connections to combined sewers shall be trapped as required in the Specification Details.

10.00 REMOVALS, REPLACEMENTS AND MODIFICATIONS

10.01 **REMOVING EXISTING MANHOLES**: Existing manholes shall be removed, where indicated on the drawings or as directed by the Engineer. The frame and cover shall be removed and delivered to the Owner. All abandoned pipes shall be bulk headed and either the manhole removed and the area backfilled as specified under "Excavation and Backfill", or, if in good condition, removed to a depth of three feet below grade, filled and compacted to 95% Standard Proctor Density with approved granular fill materials.

10.02 **REMOVING EXISTING CATCH BASINS**: Existing catch basins shall be removed, where indicated on the drawings or as directed by the Engineer. The frame and cover shall be removed and delivered to the Owner. The masonry, or pipe, shall be completely broken, removed and disposed of by the Contractor. All abandoned pipe connections shall be bulk headed at both ends where accessible. The area occupied by existing catch basins shall be backfilled after their removal as specified under "Excavation and Backfill.

10.03 **REPLACING EXISTING CASTING**: Where noted on the plans and/or as directed by the Engineer, existing manhole and/or catch basin castings shall be removed and replaced with a new casting as hereinbefore specified.

This item includes adjustment of the structure as specified in Section 10.06.

10.04 **REHABILITATING EXISTING MANHOLES**: Existing manholes shall be rehabilitated as directed by the Engineer. Rehabilitation consists of all work required to improve the condition of manholes which does not necessitate the removal of the manhole wall structure. Work may include grouting and sealing of the manholes, removing and replacing flow channels, replacing manhole castings and any other work required by the Engineer.

10.05 **ADJUST MANHOLE, CATCH BASIN, INLET, WATER BOXES, OR GATEWELL FRAME AND COVER**: Refer to section 9.10, “Masonry Manholes”, for sewer wall construction on structures. Adjusting shall consist of setting a casting to the proper elevation and shall include saw cutting, removal and replacement of pavement, deteriorated brick or mortar to a depth of three rows of brick or 6 inches as measured from the bottom of the casting. Brickwork below this depth shall be considered a reconstruct.

This item also includes placement of granular backfill and removal and disposal of unsuitable excavated material and debris such as brick or block to a recognized landfill.

10.06 **RECONSTRUCT CATCH BASIN, MANHOLE OR GATEWELL TO THREE FEET BELOW TOP OF MASONRY STRUCTURE**: Refer to Section 9.10, “Masonry Manholes”, for sewer wall construction on structures. Reconstruction shall consist of removing all loose or deteriorated brick, block and mortar to a solid base or to 3 feet below the bottom of casting.

This item also includes setting the casting to the proper elevation, placement of granular backfill or sand around the structure and the disposal of unsuitable excavated material and debris such as brick or block to a recognized landfill.

10.07 RECONSTRUCT CATCH BASIN, MANHOLE, INLET OR GATEWELL (ADDITIONAL DEPTH) FROM THREE FEET BELOW TOP OF MASONRY STRUCTURE TO BASE: Refer to Section 9.10, "Masonry Manholes" for sewer wall construction on structures. This item covers reconstruction of structure from 3 feet below top of masonry structure to the footing or cookie (base). This item also includes the installation of traps if required, placement of granular backfill or sand around the structure and the disposal of unsuitable excavated material and debris such as brick or block to a recognized landfill. Payment of this item shall be by the vertical foot.

10.08 CLEANING: During construction, all debris shall be removed from flow channels and sewage flow shall be maintained. Prior to final acceptance by the City of any contract or project, all structures shall be thoroughly cleaned of all debris as a result of the construction. All inlets and catch basins shall be vacuumed clean of all debris, which shall be disposed of at a recognized landfill. Cleaning shall be included as part of other contract or project unit costs.

10.09 4 INCH OR 6 INCH CORRUGATED PLASTIC EDGE DRAIN INCL. GEOTEXTILE WRAP AND BACKFILL: Refer to 2020 MDOT Standard Specifications for Construction, Sections 404, and Subsections 909.07B and 910.05, as well as the detail shown with the plans. All edge drain installed shall be 6 inch diameter, except where 4 inch diameter edge drain is indicated on plan sheets. Edge drain shall be corrugated polyethylene tubing with perforations and a geo-textile wrap conforming to MDOT section 910.05. The edge drains shall be installed as indicated on plans and the work shall include connections to existing edge drain when indicated on the plans or directed by the Engineer. The installation of the edge drain shall be done as follows:

A. The invert elevation shall be 36 inches below finish grade or as directed by the Engineer.

B. The upstream end shall be plugged with the manufacturer's recommended cap.

C. The backfill up to subgrade elevation shall be done with MDOT 34R Aggregate (pea gravel).

D. The connection to the catch basins or inlets, when the edge drain will be installed in both directions from the structures, shall be done with a tee and the connection will be incidental to the edge drain item.

E. Payment shall be by the linear foot measured in place.

11.00 SEWER LINING

11.01 DESCRIPTION OF WORK: As follows:

A. Work Included - This work shall include mobilization; cleaning of sewers, including removal of all debris; inspection; lining the sewer and restoring the area.

This work shall also include dewatering of existing sewers to a degree necessary for the lining operations with payment incidental to work under this section and an inspection report.

B. The Owner will provide access to manholes and furnish installation and flushing water from designated fire hydrants. The Contractor shall contact the Owner to

coordinate these items. The Owner will not provide a dump site for disposal of debris removed from sewers.

11.02 QUALITY ASSURANCE: As follows:

A. Reference Standards - Performance and material requirements shall meet specific Reference Standards referred to hereinafter under individual items.

B. Tests - Testing shall be accomplished as specified hereinafter under individual items.

11.03 SUBMITTALS: As follows:

A. Shop Drawings and Guarantees - Furnish Shop Drawings and Guarantees covering the items included under the Contract.

B. Lining Inspection Report - two (2) external hard drives, each containing all inspection reports, CCTV video recordings (pre- and post-lining videos), and other data including material testing reports from an independent testing consultant, shall be provided to the City, and they shall become the property of the City. Each external hard drive shall be externally labeled to include contract number, contract title, and contractor's information.

The inspection reports shall include a complete pre-lining summary and post-lining summary, logging each section of sewer televised. These summary reports shall be assembled so that individual sewer reports are filed in ascending order by structure identification number.

The summary reports shall contain an index of all sewer runs that were televised. Included in the report shall be the exact location and limits of the relining. Televising shall be performed in accordance with Section 8.03.

11.04 SITE CONDITIONS: It is required that the Contractor familiarizes himself with site and working conditions by making a personal examination of the site or sites and its surroundings.

11.05 MOBILIZATION: This item shall include the furnishing of all machinery, tools, materials, equipment, transportation and labor to accomplish the work specified herein. Also included are the proper cleanup of the premises and removal of all unused materials, tools, machinery and equipment from the site upon completion of the work.

11.06 CLEANING: The Contractor shall provide all equipment necessary for the proper rodding, brushing, flushing and dewatering of the sewers prior to the lining operation.

All dirt, debris, roots and other material removed from the sewers shall be loaded and hauled away by the Contractor to a landfill acceptable to the Engineer.

Dewatering shall include necessary pumping equipment, plugs and temporary piping between manhole sections.

Cleaning of the sewer shall be carried out in accordance with the General Specification for Sewer Cleaning to the extent that the sewer section can be accurately inspected to evaluate and prepare the section for lining.

11.07 TELEVISION INSPECTION: This work shall include dewatering or diverting flow in sewers to the degree necessary for the television inspection for lining operations.

Dewatering shall include necessary pumping equipment, plugs and temporary piping between manhole sections.

The Contractor shall, prior to starting work, furnish the Engineer for approval, his proposed method for dewatering sewers.

A. Closed-Circuit Television - The Contractor shall furnish all labor, electronic equipment and technicians to perform the closed-circuit television inspection of the sewers. Operation of the equipment is to be controlled from above ground with a skilled technician at the control panel in the television studio, controlling the movement of the television studio, controlling the movement of the television camera. The technician shall have the capability to adjust the brilliance of the built-in lighting system and be able to change the focus of the television camera by remote control. The technician will provide clear audio description during the videotaping.

The monitor shall be located inside a mobile TV studio. The stationing of the television camera shall be continuously displayed on the television monitor while the sewer line is inspected. The Contractor's mobile studio shall be large enough to accommodate up to 3 people for the purpose of viewing the monitor while sewer inspection is in progress. The Owner's representative shall have access to view the television screen at all times.

One (1) copy of the pre-lining television inspection report and one (1) copy of the pre-lining video on USB (Universal Serial Bus) flash drive, must be furnished to the engineer at least three (3) working days prior to lining of each sewer run. The pre-lining television inspection report shall serve as field verification by the contractor of the existing pipe diameter and total number of service connections.

Upon completion of the reconnection of all service connections within a lined sewer, one (1) copy of the post-lining television inspection report and one (1) copy of the post-lining video on USB flash drive must be furnished to the engineer prior to the City processing a progress payment for the completed work.

All television inspection shall be recorded in color on USB flash drive or on external hard drive approved by the engineer for final submittal. Audio information shall be included on the recording which shall correspond to the information to be logged on the TV inspection report for the sewer run.

Each USB flash drive shall be labeled to include the contract number, USB flash drive number, and whether the recordings are pre-lining or post-lining.

In addition, the type of tags or labels for USB flash drive labeling shall be approved by the engineer prior to submittal and shall be labeled to list all sewer runs contained on the USB flash drive by listing the manhole identification numbers for each sewer run.

Unless otherwise approved by the Engineer, sewer defects and features shall be coded on each report utilizing the NASSCO (National Association of Sewer Service

Companies) Pipeline Assessment and Certification Program (PACP) software. Each sewer report shall indicate that the televising is either pre-lining televising or post-lining televising.

B. Instant Photographs - The Contractor shall furnish all equipment required for taking instant photographs of the view which appears on the monitor. During the course of the inspection, the Engineer shall indicate the specific views which are to be photographed.

C. Obstructions in the Line: - If after viewing the video tape of the sewer to be lined, the Contractor feels he will have difficulty passing the service lead cutter or any other necessary equipment through the lines sewer, he shall, at his own expense, run a gauge of sufficient size through the unlined pipe to determine if the equipment can pass through. Any obstructions which may need to be cleared must be identified to the Engineer prior to lining of the sewer. Obstructions encountered after lining of the sewer which have not previously been identified by the Contractor shall be repaired at the Contractor's expense. The Owner reserves the right to delete lining of sections of sewer in which spot repairs are required prior to sewer lining.

D. Final Submittals: two (2) external hard drives, each containing all inspection reports, CCTV video recordings (pre and post-lining videos), and other data including material testing reports from an independent testing consultant, shall be provided to the City, and they shall become the property of the City. Each external hard drive shall be externally labeled to include contract number, contract title, and contractor's information.

The inspection reports shall include a complete pre-lining summary and post-lining summary, logging each section of sewer televised. These summary reports shall be assembled so that individual sewer reports are filed in ascending order by structure identification number. The summary reports shall contain an index of all sewer runs that were televised.

11.08 **LINING**: The locations of the existing sewer sections to be lined are shown on the plans. Where indicated on the plans, the liner shall be equal to a liquid thermosetting resin impregnated polyester felt installed by hydraulic inversion.

Lining with Impregnated Felt:

A. General - All materials used in the lining and in the insertion process under the Contract shall be of their best respective kinds and to the satisfaction of the Engineer. The Contractor shall supply shop drawings / submittals for approval of materials prior to manufacturing of the liner. Shop drawings shall include resin make-up and epoxy type and shall list all fillers and pigments used, if any. Also indicate reinforcing materials, mechanical strengtheners or if membrane of other materials are used. Thickness of cured liners and quantity of layers shall be indicated. Any materials not approved by the Engineer shall be rejected prior to the insertion of the liner into the sewer. These rejected materials shall then be replaced, with approved materials, at the Contractor's expense.
The liner shall be fabricated to a size that, when installed, will neatly fit the internal circumference of the conduit to be lined as specified by the Engineer. Allowance for

longitudinal and circumferential stretching of the liner during insertion shall be made by the Contractor

B. Material -

1. Resin - The polyester resin shall be a resin catalyst system compatible with the requirements of the project and approved by the Engineer. A sample of each batch, suitably labeled, shall be tested or certified as specified and approved by the Engineer prior to its use.

2. Alkaline Resistance of Polyester Resin. - Test pieces will be prepared from a sample of resin and catalyst as supplied from any one batch of resin to be used by the Contractor. The sample will then be tested by a method approved by the Engineer prior to execution.

   After the test cycle, samples will be weighed and the resin shall be deemed to be acceptable if the weight loss is less than 10% of the original weight of the samples under test.

3. Fillers and Pigments - The resins used shall not contain fillers, except those required for viscosity control or fire retardation. Up to 5% of mass thixotropic agent which will not interfere with visual inspection may be added for viscosity control. Resins may contain pigments, dyes or colorants which will not interfere with visual inspection of the cured liner.

4. Epoxy Resin - The use of epoxy resins compatible with the system to impregnate the liner bag may be permitted in some circumstances. The use of suitable fillers maybe permitted. The use of epoxy resin in any liner bag maybe requested by the Contractor, if conditions are deemed to warrant their use, but approval in writing must be given to the Engineer before installations.

5. Reinforcing Material - The reinforcing material of the felt liner bag shall be of a needle interlocked polyester felt, or other material approved by the Engineer, formed into sheets of required thickness as shown on the drawings. Bags shall be made of single or multiple layer construction where any layer shall not be less than 1.5 mm thick. A suitable mechanical strengthener membrane or strips may be sandwiched in between layers where required to control longitudinal stretching. A polyurethane membrane used during insertion maybe left on the internal surface of the liner after curing. A bonded polyurethane membrane and inner liner, if used shall not affect the structural dimension requirements of the cured liner.

6. Liner Thickness - The thickness of the cured liner shall be accurately measured and shall not be more than 5% less than the thickness specified. The minimum thickness of the cured liner shall be 6 mm thick.

7. Felt and Resin Content of Liner - The samples shall be visually inspected to ensure the number of layers of felt conforming to the specified number of layers and thickness.

   Cured resin shall be leached from the liner by a suitable process and the resin to felt ratio by weight calculated shall conform to that specified.

8. Mechanical Properties - The cured liner shall meet the following minimum strength requirements:

   Tensile stress at yield 20° C per ASTM D638 – 3,000 psi

Flexural stress per ASTM D790 - 5,000 psi

Flexural Modulus per ASTM D790 - 500,000 psi

The Contractor shall supply a representative sample of cured liner from each inversion procedure. This sample may be from waste pieces at manholes, and may be formed inside a section of pipe. The sample for testing shall be representative of the entire section of liner. An independent lab test from this final product shall confirm these properties with testing costs paid by the Contractor. If the sample fails to meet minimum strength requirements, the Contractor may be required to line the sewer again, at no additional cost to the Owner.

9. Finish - The finished lining shall be continuous over the entire length of an insertion run between two manholes and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes, pimples and delamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

   The inner surface shall be free of cracks and crazing with smooth finish and with an average of not over two pits per 300 mm square, providing the pits; are less than 3 mm diameter and not over 1 mm deep and are covered with sufficient resin to avoid exposure of the inner fabric. Some minor waviness that in the Engineer's opinion, will not appreciably decrease the flow cross-section to affect the flow characteristics or be the cause of a possible choke point shall be permissible.

   The polyurethane membrane, inflation bag, if permanently bonded and attached to the felt bag, may be allowed to remain as an inner liner. This bag, if allowed to remain, is not to be considered as part of the liner or to contribute to any of the specified properties required of the liner.

   Any defects which will affect, in the foreseeable future, the integrity or strength of the lining, shall be repaired or the liner replaced at the Contractor's expense.

C. Design, General - The Contractor shall submit with the Proposal the recommended liner thickness for each manhole to manhole section. The Contractor shall supply design calculations indicating how liner dimensions were obtained. All calculations used in the liner design will assume a Factor of Safety of 12, and the liner shall be a very close fit in the existing conduit. Liner shall be designed to withstand internal and / or external water pressures as indicated by site conditions or as directed by the Engineer.

D. Method of Installation:
   1. General - The Contractor shall deliver the uncured resin impregnated liner bag to the site and provide all equipment required to place and invert the liner into the sewer and cure it once in place.

   2. The Contractor shall notify residents a minimum of 48 hours prior to interruption of service with estimated duration of interruption.

The Contractor shall bypass the sewage around the sections of line that are to be lined. The bypass shall be made by plugging an existing upstream manhole if necessary and pumping the sewage into a downstream manhole or adjacent system. Bypassing sewage shall be incidental to all lining work. Bypassing shall include all work of dewatering or diverting flows, pumping equipment rentals and all plugs and temporary piping between manhole sections. The pump and bypass lines shall be of adequate capacity and size to handle the flow. If pumping is required on a 24 hours basis, engines shall be equipped in a manner to keep noise to a minimum. All bypassing systems shall be approved by the Engineer. Approval of the bypassing system by the Engineer shall in no way be construed as relieving the Contractor of any responsibility under this Contract as related to the protection of the interest of the Owner and the general public. Sewer service shall not be interrupted for longer than 24 hours and work shall be done at the times causing least inconvenience to residents as directed by the City of Royal Oak. Under no circumstances will be dumping of raw sewage on private property or in City streets be allowed.

It shall be the responsibility of the Contractor to clean the line of obstructions, solids, dropped joints, protruding services, or collapsed pipe that will prevent the insertion of the liner. If inspection reveals an obstruction, such as a badly dropped or misaligned joint, or service protrusion, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction.

Such excavation shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a pay item as listed in the Proposal if the misalignment or protrusion is equal to or more than fifteen (15) percent of the internal diameter of the sewer pipe being lined - as determined by the Engineer from television pictures. If the obstruction or protrusion is less than fifteen (15) percent of the sewer internal diameter, or could have been removed by bucket machines, or swabbing using conventional cleaning methods, payment will not be made.

3. Transportation to Site - The liner bag shall be impregnated with resin not more than 48 hours before the proposed time of installation and stored out of direct sunlight at a temperature of less than 50^0F (4^0C).

4. Liner Inversion - Clean water at ambient mains temperature shall be available from the Owner at the nearest fire hydrant to the inversion location.

5. Liner Curing - The Contractor shall supply a suitable heat source and water recirculation equipment capable of delivering hot water to the far end of the liner for curing purposes. Hot water cure is preferred to be used for curing of liner, however, steam may be allowed for 12-inch diameter pipes and smaller.

6. After the liner has been cured, all existing active service connections shall be re-opened or re-instated immediately after or the same day after lining. All service connections shall be restored to their full diameter within one week of the time that the pipe was lined. The Contractor shall be responsible for

damages resulting from any house-lead backups which result from service laterals not being fully opened.

The reconnection of services shall be done without excavation, from the interior of the pipeline by means of a remote-controlled television camera directed mechanical cutting device. Location of the service shall be from the pre-lining internal inspection records and camera observation.

The remote-controlled camera directed mechanical cutting device shall re-establish the service in such a way that a smooth edge is established between the lateral and the pipeline. The liner shall be sufficiently tight so that there is no annular space between the connection and the line. The cost of testing and pre-connection service shall be considered included to the cost of lining in each section.

12.00 SPOT SEWER REPAIRS

12.01 DESCRIPTION OF WORK: This work shall include the furnishing of labor, materials and construction equipment necessary for the repair of segments of existing sewer as shown on the drawings or as directed by the Engineer. Work shall include furnishing and installation of the pipe and bedding, connecting to existing sewers, and televising of the installed pipe.

12.02 QUALITY ASSURANCE: All materials furnished by the Contractor must conform in all respects to the following standard specifications. Where reference specifications are used, they shall be considered as referring to the latest edition. Unless otherwise indicated, any material furnished by the Owner will also conform to these specifications.

A. Reference Standards:

ASTM C14	Sewer Pipe (CSP)
ASTM C76	Reinforced Concrete Sewer Pipe (RCSP)
ASTM C655	Reinforced Concrete Sewer Pipe (RCSP)
ASA A21.4	Ductile Iron Pipe (DIP) cement lined, standard thickness
ASA A21.51	Ductile Iron Pipe (DIP) cement lined, standard thickness
ASTM C425	Clay Pipe Joints
ASTM C594	Clay Pipe Joints
ASTM C443	Joints in Concrete or Reinforced Concrete Pipe
ASTM C361	Joints in Concrete or Reinforced Concrete Pipe
AWWA C320	Joints in Concrete or Reinforced Concrete Pipe
ASTM C361	Joints in Concrete or Reinforced Concrete Pipe
AWWA C301	Joints in Concrete or Reinforced Concrete Pipe
AWWA C302	Joints in Concrete or Reinforced Concrete Pipe
ASA A21.11	Joints in Ductile Iron Pipe
MDOT 8.02.06	Natural Sand 2NS
ASTM - D2680	ABS Truss Pipe
ASTM D2751 & SDR 23.5	ABS Solid Plastic Pipe
ASTM D2241	PVC Pipe
ASTM D3034 (SDR 26)	PVC Solid Pipe
ASTM F679 (PS 115)	PVC Solid Pipe

ASTM D1784 .....PVC Compounds
ASTM D3139 .....Joints in PVC Pipe
ASTM F477.....Joint Gaskets

B. Certification of Pipe - All pipe delivered to the jobsite shall be accompanied by certification papers showing that the pipe has been tested in accordance with the applicable Specifications and that the pipe meets the Specifications for this project.

C. Tests - The television inspection will be done as specified hereinafter.

12.03 **SUBMITTALS**: Shop Drawings - Furnish shop drawings of the items proposed under the Contract. Design details of the joint shall be submitted to the Engineer for his consideration and approval before ordering any pipe.

12.04 **SEWER PIPE:** All sewer pipes shall meet the requirements of the Quality Assurance Reference Standards shown hereinbefore.

All joints shall meet the requirements of the Quality Assurance Reference Standards shown hereinbefore.

Replacement pipe shall be of the same diameter as the existing sewer or, in case of odd-sized pipe, replacement pipe shall be the next larger, commercially available pipe size. Clay pipe 12 inches in diameter or larger shall be replaced with a like size of reinforced concrete sewer pipe, as listed in the Proposal. Lines smaller than 12 inches may be replaced with plastic PVC pipe. Connections shall be made with appropriate "Fernco" couplers.

12.05 **LAYING PIPE**: Prior to placement of any pipe, the actual sewer grade between the end points of the repair shall be determined. End points of the dig-up repair shall be exposed in order to determine the correct grade. The Contractor shall be responsible for determining the grade and reporting the grade to the Engineer.

Each pipe shall be inspected for defects prior to being lowered into the trench. The inside of the pipe and outside of the tongue shall be cleaned of any direct or foreign matter. Joint materials shall be placed as recommended by the manufacturer.

All 15 inches diameter and larger sewer shall be installed with stone bedding from a minimum 4 inches below bottom of pipe up to the mid-point of the pipe. The stone to be supplied shall be MDOT Coarse Aggregate 6A placed in 6 inch layers and compacted to 95% Modified Proctor Density. When directed by the Engineer, a concrete cradle shall be placed in lieu of the stone bedding.

The pipe shall be centered in the grooves, and pushed tight together to form a smooth and continuous invert. Mechanical means shall be used for pulling the pipe home in making up the joint and for holding the pipe joints tight until completion of the line. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come-along for pulling the pipe home and holding the pipe in position.

The Contractor shall verify the grade of the repair by running a string line along the entire repair prior to backfilling of placing flowable fill. The grade shall be within ¼ inch +- of constant grade.

After the pipe is laid, the bedding, specified hereinafter, shall be carefully compacted under the haunches of the pipe, and the trench shall be backfilled to 12 inches above the pipe as specified under "Excavation and Backfill" section. Sufficient backfill shall be placed after each joint is made along the sides of the pipe to offset conditions that might tend to move the pipe off line and grade. Any pipe found off grade or out of line shall be re-laid properly by the Contractor at no expense to the Owner.

12.06 **SEWER BEDDING (CONCRETE CRADLE) AND BACKFILLING**: The replacement sewer pipe shall be bedded on a concrete cradle as hereinafter specified when directed by the engineer. The cradle shall extend at least 12 inches into the portion of existing pipe that is to remain and along the replacement pipe from the connection point. The pipe shall be locked into correct alignment and grade prior to placement of the concrete cradle. The grade at the connection shall be checked by a string line prior to placement of the cradle and prior to backfilling the trench. After setting the pipe, the space between the outside of the pipe and the undisturbed trench bank shall be filled with concrete as shown on the drawings. The concrete shall be technically vibrated to insure complete filling of the annual space between the excavated face of the original ground and the outside face of the pipe. The concrete shall be allowed to set up for a minimum of 24 hours or have achieved a minimum strength of 400 psi prior to backfilling of the trench.

Sewer bedding and backfilling, other than as specified herein, shall conform to "Excavation and Backfill" section.

12.07 **TRENCH EXCAVATION**: Excavation of the trench for spot sewer repairs shall conform to "Excavation and Backfill" section. The Contractor shall limit the trench width such that the maximum width at the level on top of the pipe is not more than the O.D. of the pipe plus 12 inches on each side. The Contractor shall carefully select his excavation equipment to ensure that this maximum width is not exceeded.

12.08 **SEQUENCE OF CONSTRUCTION**: Once the spot repair has been completed, the trench shall be backfilled and compacted. Temporary pavement shall be placed on the trench the same day the repair is backfilled. Temporary pavement shall consist of cold patch for paved streets and road gravel for unpaved streets. Within two (2) weeks of completion of the repair, it shall be televised in accordance with Section 8.03 and the DVDs and reports from the inspection delivered to the Engineer. The City shall then review the DVDs and determine the acceptability of the repair. Within two (2) weeks after acceptance of the repair, final pavement restoration shall be completed. Spot repairs which are not accepted by the City shall be re-excavated and corrected within two (2) weeks of notification to the Contractor from the City.

12.09 **CONNECTION TO EXISTING SEWERS**: All connections between new pipe and existing lines including private laterals shall be in accordance with Section 7.04.

The connection to the existing sewer shall be constructed such that there is no offset or gap at the joint. Joints offset more than 1/2 inch and joints gapped more than one (1) inch apart are unacceptable and shall be repaired by the Contractor prior to final payment.

12.10 **CONTROL OF FLOW**: The Contractor shall bypass pump all flow entering the manhole upstream of the repair either to the manhole downstream of the repair or to a manhole

on an adjacent sanitary or combined sewer. The sewer trench shall be kept dry at all times during the duration of the repair.

12.11 **CONCRETE CUTS**: When the trench must be cut through concrete pavement, driveway or sidewalk, particular care shall be taken not to unnecessarily damage the adjoining areas of the pavement driveway or sidewalks. All cuts through existing surfaces shall be made with a concrete saw, sawing full depth.

12.12 **CONCRETE ENCASEMENT**: Concrete for encasement shall be concrete as specified in the Contract specifications, with that below the pipe mixed dry. Concrete encasement shall be built to the form and dimensions shown on the plans. Particular care shall be taken to bed the pipe in concrete so that a complete support of the pipe shall be made. Encasement at the sides and top shall be placed in a manner so that the pipe will not be disturbed or floated from its bedding.

12.13 **CONNECTIONS TO EXISTING MANHOLES**: The Contractor shall furnish all labor and materials for the connections of sewers and catch basin leads under the Contract to existing manholes, structures and catch basins as called for on the drawings. Refer to Article 7.05.

12.14 **WYE BRANCH CONNECTIONS**: Wye branch connections shall be provided at such points as are shown on the drawings or as directed by the Engineer. This shall be of the size and character indicated on the drawings. Branch connections shall be formed by the use of standard wye-branches. Wyes shall only be installed with standard bell and spigot sections. Wyes shall be provided to connect existing services only.

12.15 **CORED TAP**: For sewers 18 inches or larger in diameter with 2.5 inches of wall thickness or larger, cored taps may be used in place of wyes. The cored tap shall be made with a coring machine which will create a clean and circular opening in the sewer pipe. The opening shall not be larger than the outside diameter of the surface lateral pipe plus 10%.

A rubber boot assembly to be inserted in the cored opening shall be equal to a Kor-N-Tee Assembly with a stainless steel Korband shall be used to connect the service lateral to the pipe. The lateral shall not protrude into the pipe. Cored taps shall be positioned away from joints on the proposed combined sewer and shall be drilled to align the center of the proposed sewer lead with the center of the proposed combined sewer. The core diameter shall be as recommended by the manufactures of the rubber boot. The external stainless-steel band on the boot shall be tightened to manufacturer's recommendation upon insertion of the proposed sewer lead.

For sewers 15 inches and smaller in diameter with less than 2.5 inches of wall thickness, tee or wye tap saddles shall be used. Flexible tap saddles shall be secured using a “slip-lock” clamps of stainless-steel band and shall be tightened per the manufacturer’s recommendation. For larger than 15-inch diameter sewer mains, stainless-steel extension clamps or bands shall be used. The flexible tap saddles shall be manufactured by Fernco or its equivalent.

12.16 **RISER PIPE**: Where directed by the Engineer, or shown on the drawings, the Contractor shall furnish and place risers, of the size and type shown on the drawings and / or as listed on the Proposal, extending from the branch opening of the sewer up to

the established elevation of the house sewer service lateral, as hereinafter specified or to such an elevation as will provide existing or future service. These risers shall be laid up and held in place in a substantial manner and surrounded by concrete as shown on the drawings. Openings in the top of the riser pipe shall be closed by means of stoppers as specified.

12.17 **SERVICE LATERAL CONNECTIONS**: Whenever indicated or noted on the drawings, house connection sewers shall be installed and connected to existing house plumbing. The connections shall be constructed with couplings as hereinbefore specified. The service lateral shall have a minimum fall of ¼ inch per foot. Connections shall use 6-inch P.V.C. SDR 26 pipe unless otherwise approved by the Engineer.

13.00 **METHOD OF MEASUREMENT AND BASIS OF PAYMENT**: Upon the completion of the Contract, the items listed in the Proposal will be measured and/or counted in the presence of the Contractor. Payment will be made at the listed unit prices.

Any work not specifically listed as a payment item in the Proposal shall be considered as included in other payment items of work.

13.01 **SEWERS**: Sewers will be measured from center to center of manholes with no deductions for wyes or other fittings. The depth of the sewer connecting two adjacent structures shall be considered as being the average of the depth from earth grade to the sewer invert at these structures.

13.02 **SEWERS THROUGH ENCASEMENTS**: Sewers through encasements under highways, railroads, etc., will be measured through the encasement. Bedding of sewer in the encasement is considered incidental.

Stubs shall be considered as footage of sewer. Adapters and plugs are considered incidental.

13.03 **HOUSE SERVICES**: House services shall be measured horizontally from sewer centerline and the unit price shall include the cost of the elbow and plug, blocking and marker. No deduction will be made for wyes, elbows or risers.

13.04 **RISERS, CLEANOUTS, WYES AND TEES**: Risers, cleanouts, wyes and tees shall be paid for at the contract unit price.

13.05 **MANHOLE DEPTHS**: Manhole depths will be measured from the lowest invert to the top of the casting.

13.06 **SURFACE RESTORATION**: See standard specifications for Excavating and Backfilling.

GENERAL SPECIFICATIONS FOR SEWERS- SEWER CLEANING

1.00 **GENERAL**: Sewer cleaning shall include all work required to clean sewers for inspection by closed circuit television and / or chemical grouting operations. Work included in cleaning of sewers shall include providing necessary equipment and personnel, dislodging materials from the sewer pipe, removal of the debris from the system and the transport and disposal of debris removed. A disposal site will not be provided by the Owner. The contractor shall not begin any cleaning work without notifying affected residents at least 24-hours in advance of the scheduled work. The contractor shall perform the sewer cleaning work within 48-hours of the date set on the notice. Payment for handing-out notices to affected residents prior to cleaning shall be considered included in the sewer cleaning items of the contract.

1.01 **CLEANING EQUIPMENT**: The equipment used for sewer cleaning shall be capable of removing all dirt, grease, rocks, roots and other deleterious materials. The equipment shall be selected by the Contractor to prevent damage to the pipe. The equipment may include high velocity water-jetting equipment, vacuum machines, hydraulically propelled equipment or mechanically powered equipment. If a rodding unit is used, it shall be able to pull brushes, swabs and other cleaning equipment as well as the television camera. The rodding unit shall have a footage meter attached so that the location of the cleaning tools and / or television camera will be known at all times. Necessary pulleys and supports shall be installed in manholes so as not to restrict the cleaning operation or damage existing manholes.

Root cutting, mineral deposits removal, and cutting of protruding service connections shall be performed with the assistance of a CCTV camera to visually direct and guide the cutter to efficiently perform the work while keeping the sewer line undamaged. All labor and equipment associated with the work to assist the cutter with a CCTV camera in order to perform the work as described herein shall not be paid for separately, but all costs shall be considered as included in the unit prices bids for sewer cleaning, mineral deposits removal, or cutting of protruding service connections.

Cleaning equipment capable of cleaning lengths up to 1000 feet shall be provided. Equipment must be able to clean this length with vehicular access to one manhole only.

Chain style cutter or chain knockers shall not be allowed to be used for the work. The pipe wall surface shall have a smooth finish when completed. Grinding shall be completed with a diamond or carbide tip cutter approved by the engineer. Removal of mineral deposits by grinding shall be assisted by a CCTV camera. Prior to any cleaning operation, the contractor shall submit a list of grinding tool to be used for approval.

1.02 **CLEANING PRECAUTIONS**: During sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools or tools which retard the flow in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from the fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

1.03 **SEWER CLEANING**: Sewer cleaning shall consist of removing dirt, grease, rocks, sand, roots and other materials and obstructions from the sewer lines and manholes. Cleaning shall be of the entire reach between manholes. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted.

The majority of roots shall be removed in the sections where chemical root treatment has been applied. Special attention should be used during the cleaning operation to assure almost complete removal of roots from the joints in any lines designated for joint testing. Any roots which could prevent the proper application of chemical sealants shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners.

1.04 **SEWER CLEANING PRIOR TO ROOT TREATMENT**: Sewer cleaning which is being performed to facilitate root treatment is intended to clear the line of large accumulations of dirt, grease, and other materials which hamper root treatment. Cleaning prior to root treatment shall thoroughly clean the line of dirt and sediment. High pressure jet cleaning shall be used for pre-cleaning of sewers unless other methods are approved by the Engineer. Mechanical cutting tools shall not be used in sewers prior to root treatment unless there is such dense root intrusion or solid material in the pipe that the flow of treatment would be rendered ineffective. Sewers which are designated for television inspection prior to root treatment shall be cleaned to the extent required under inspecting.

1.05 **REMOVAL AND DISPOSAL OF DEBRIS**: All sludge, dirt, sand, rocks, grease, roots and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage to pumping equipment, shall not be permitted. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of. All material shall be removed from the site no less often than at the end of each workday. Under no circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as approved by the Owner.

1.06 **ACCEPTANCE OF SEWER CLEANING**: Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Engineer. If TV inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to re-clean and re-inspect the sewer line until the cleaning is shown to be satisfactory.

GENERAL SPECIFICATIONS FOR SEWERS- SEWER FLOW CONTROL

1.00 SEWER FLOW CONTROL

1.01 GENERAL: This work shall include dewatering or diverting flow in sewers to the degree necessary for the television inspection. Flow control shall be incidental to other work performed under the Contract.

Flow control shall be used whenever required to bring the depth of flow within the range specified below for television inspection.

The Contractor shall, prior to starting work, furnish the Engineer, for approval, his proposed method for dewatering sewers.

1.02 DEPTH OF FLOW: When sewer line depth of flow at the upstream manhole of the sewer section being worked on is above the maximum allowable for television inspection, joint testing and / or sealing, the flow shall be reduced to the level shown below by plugging or blocking of the flow, or by pumping and bypassing of the flow as specified.

Depth of flow shall not exceed that shown below for the respective pipe sizes as measured in the upstream manhole when performing television inspection, joint testing and / or sealing.

Maximum Depth of Flow – Television Inspection

06”-10” Pipe ..... 10% of pipe diameter
12”-24” Pipe ..... 15% of pipe diameter
27” & up Pipe ..... 20% of pipe diameter

1.03 PLUGGING OR BLOCKING: A sewer line plug shall be inserted into the line upstream of the section being worked. The plug shall be so designed that all or any portion of the sewage can be released. During TV inspection, testing and sealing operations, flow shall be reduced to within the limits specified above. After the work has been completed, flow shall be restored to normal.

1.04 PUMPING AND BYPASSING: When pumping and bypassing is required, the Contractor shall supply the pumps, conduits, and other equipment to divert the flow of sewage around the sewer section in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during a rainstorm. The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to minimize noise. Sewage from any sanitary or combined sewers shall not be bypassed or discharged into any storm sewer lines.

1.05 FLOW CONTROL PRECAUTIONS: When flow in a sewer line is plugged, blocked or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

GENERAL SPECIFICATIONS FOR SEWERS- TV INSPECTION / ROOT TREATMENT

1.00 TELEVISION INSPECTION

1.01 GENERAL: Under this work, the Contractor shall furnish all materials, labor, equipment and all else necessary for performing a television inspection of existing sewers.

The flow in the section being inspected shall be suitably controlled as specified (see Sewer Flow Control). The inspection shall be carried out under the supervision of the Engineer.

1.02 EQUIPMENT: The television camera used for the inspection shall be one specifically designed and constructed for such inspection and the equipment shall be capable of televising sewer run lengths of up to 800 feet. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner, and if unsatisfactory, equipment shall be removed, and no payment will be made.

All television inspection shall be recorded in color on DVD (Digital Versatile Disc) or on USB (Universal Serial Bus) flash drive/s and on an external hard drive approved by the Engineer and the recordings shall be provided to the City. Recordings shall have both audio and video of acceptable quality and free of interference and background noise. The DVD recordings shall be provided in a standard media format which can be read by a Microsoft Windows media player. No proprietary software programs shall be needed to view and hear the recordings.

Each DVD or USB flash drive turned over to the Owner shall be furnished with a hard case having external labeling that can be seen without opening the case. All DVDs shall be finalized by the Contractor so that they cannot be accidently recorded over. The Contractor shall store and transport each DVD in an upright position away from magnetic sources and within temperatures above 40°F to below 80°F.

1.03 PROCEDURE: The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds, or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

If the camera encounters a dip in the sewer such that water is standing above the springline of the sewer pipe, and if the camera lens becomes submerged because of this condition, the camera rig shall be withdrawn from the sewer and inserted from the other end as far as possible. At all times, backflooding into the reach from the adjacent section shall be prevented.

When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.

The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Owner.

1.04 **DOCUMENTATION OF TELEVISION INSPECTION**: Two sets of printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of service connections, blind sewer taps, unusual conditions, roots, corrosion, cracking, and other discernible features will be recorded. One set of this information shall be turned over to the Engineer upon the completion of the inspection of each line. The second copy of the information shall be held by the Contractor. Upon completion of the project, two copies of an inspection report shall be submitted to the Owner.

Each sewer inspection report shall be formatted and coded using a Pipeline Assessment & Certification Program (PACP) standard, unless otherwise approved in writing by the engineer. PACP Pipelogix software or any NASSCO (National Association of Sewer Service Companies) PACP certified reporting software shall be utilized, or an approved equal.

2.00 ROOT TREATMENT

2.01 **GENERAL**: This work shall include treating sections of sewer as shown on the plans with a chemical root control agent capable of killing roots within the sewer line and inhibiting their re-growth without permanently damaging the vegetation producing the roots. The Contractor shall take all precautions up into buildings through building sewer connections. Any damage resulting from the agent being forced into buildings shall be repaired at no cost to the Owner.

The work shall include providing suitable root control agent; storage for the agent; proportioning, mixing and installing the instructions; keeping necessary records; hauling the materials in accordance with all necessary safety and cleanup requirements; and diverting the existing flow in the sewer line when required. Adequate ventilating system shall be provided to comply with applicable safety requirements.

Root treatment shall precede sewer cleaning except when flow is sluggish and contains sludge and grease accumulations or where TV inspection prior to root treatment is called for. In these instances, the sewer shall be cleaned as hereinafter specified before root treatment. Cleaning, when required, shall precede root treatment by a minimum of six (6) weeks.

Root treatment shall be scheduled to allow a minimum of thirteen (13) weeks prior to cleaning for the dead root mass of the smaller roots to decompose and slough off and to allow some of the heavier root branches to become brittle.

2.02 **ROOT CONTROL MATERIAL**: The active component for destroying intruding roots shall be a potent, nonsystematic toxin which will kill contacted roots at low concentrations, but which will not permanently affect parts of the plant distant from the

treated roots. The active ingredient must be spontaneously detoxified by natural chemical or biochemical processes in a relatively short interval following its use. The Contractor shall submit evidence that the ingredient will not adversely affect the performance of the wastewater treatment plant, may be removed by the normal treatment processes at the plant, and has EPA approval for use in sewer lines.

The active ingredient for destroying root intrusions shall be *sodium methyldithiocarbamate* or *diquat dibromide* and must be non-volatile in order to prevent inhalation exposure to workers, homeowners, and the general public in the vicinity of treated areas.

The surfactant system shall produce a dense, small bubble, clinging foam, which sustains its shape for a minimum of one hour and must enhance the penetration of herbicide into root masses. Products that generate foam chemically upon contact with water will not be accepted.

Root control products submitted for use that are labeled “Restricted Use: Due to Acute Toxicity” by the U.S. EPA shall not be allowed. Herbicides or pesticides submitted for use must be currently classified by the U.S. EPA as a non-carcinogen or as “not likely to be carcinogenic to humans” by either the 1986 or 2005 carcinogenicity classifications of pesticides.

In all applications the root control agent shall be dispersed into clear cool (less than 80°F, above 40°F) water free of acid, alkali, oxidizing agents, or large amounts of oil or other organic compounds or materials. Tanks used for transportation or storage of make-up water shall be free of material listed above. Extra precautions must be taken during cold weather to ensure that solution temperatures above 40°F are maintained until treatment is complete.

All foam delivered to line segments shall be generated from a solution which has been mixed for not more than 10 hours.

All materials shall be delivered to the site in undamaged, unopened containers bearing manufacturer’s original labels. A sufficient quantity of root control agent shall be stored at or near the site of the work to ensure that operations will not be delayed by shortages arising from spillage or from leakage in the treated line. The Contractor shall be solely responsible for storing root treatment chemicals. The chemicals shall be stored and handled in accordance with all applicable local, state, and federal regulations governing storage and handling of potentially hazardous materials.

Root chemical solutions shall be mixed in accordance with the label precautions and instructions. Solutions shall be mixed in the presence of a representative of the City.

Mixing and handling of the root control agent, which may be toxic under certain conditions of contact and inhalation, shall be in accordance with the recommendations of the manufacturer and applicable safety codes and shall be performed in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to ensure that chemicals are always under the control of the Contractor at all times and are not available to unauthorized persons or accessible to animals. Any damage to vegetation resulting from the misuse of the root control agent will also be the responsibility of the Contractor.

2.03 **METHOD OF APPLICATION**: Application of the chemical root control agent shall be by foaming in accordance with recommendations of the root control agent manufacturer based on conditions present in the line under treatment except soaking shall be used when directed by the Engineer. Storm sewers and combined sewers shall not be treated during rain events unless prior approval is received from the Engineer. All work must be performed by on-site commercial pesticide/ herbicide certified applicators. Certified "Pesticide Applicator" refers to a pesticide applicator duly certified and licensed by the Michigan Department of Agriculture and Rural Development (MDARD) for a commercial purpose/s.

A. Foaming

1. Foaming Agent - The chemical root control agent used in foam application shall be formulated with a surfactant capable of producing a foam able to transmit a pressure of 30 pounds per square inch and of yielding 20 gallons of foam per gallon of solution. The surfactant system shall produce a dense, small bubble, clinging foam that maintains its shape for at least 60 minutes.

2. Volume - The volume of foam injected shall be sufficient to completely fill the section of line under treatment, according to the manufacturer's instructions.

3. Application - Application of the foaming agent shall be by one of the following methods:

   a. The fumigant hose shall be inserted at the downstream manhole and pulled through the sewer to the upstream manhole. Foam shall be generated until foam appears at the upstream manhole. The hose shall then be withdrawn at a rate given by the equipment supplier until the foam appears in the downstream manhole.

   b. A split manhole technique may be used when desired by the Contractor. In this technique, a hose may be drawn from both manholes, such that the hoses meet at some point in the line. The hoses shall then be withdrawn at a rate specified by the equipment manufacturer until foam appears in the manholes at either end.

   c. For line sizes larger than 24 inches in diameter, the line may be treated by the foam coat method. The amount of foam applied shall be equal to a minimum of a 2-inch coat of foam on the inside of the pipe. The foam shall be applied by means of a foam coat nozzle. The hose shall be pulled at such a rate that cocooning of the nozzle does not occur. If necessary to prevent cocooning, the hose shall be repeatedly pulled through the line until the required volume of foam is applied. If repeated applications are required to coat the line, the hose shall be pulled, not jetted, through the line.

   d. Manholes used to access a main line sewer section for treatment must be treated as part of the main line treatment and payment for this work shall be included as part of the main line section price per foot. The Contractor must fully cover the inside manhole wall with a 3-inch coating of pesticide/

herbicide foam within 12-inches below the road or any ground surface. The Contractor must incorporate a treatment method that complies with all safety and label instructions of the pesticide or herbicide product accepted for use.

The method of foam application in which a plug is inserted at one end and foam is generated into the line until it appears at the opposite end shall not be used.

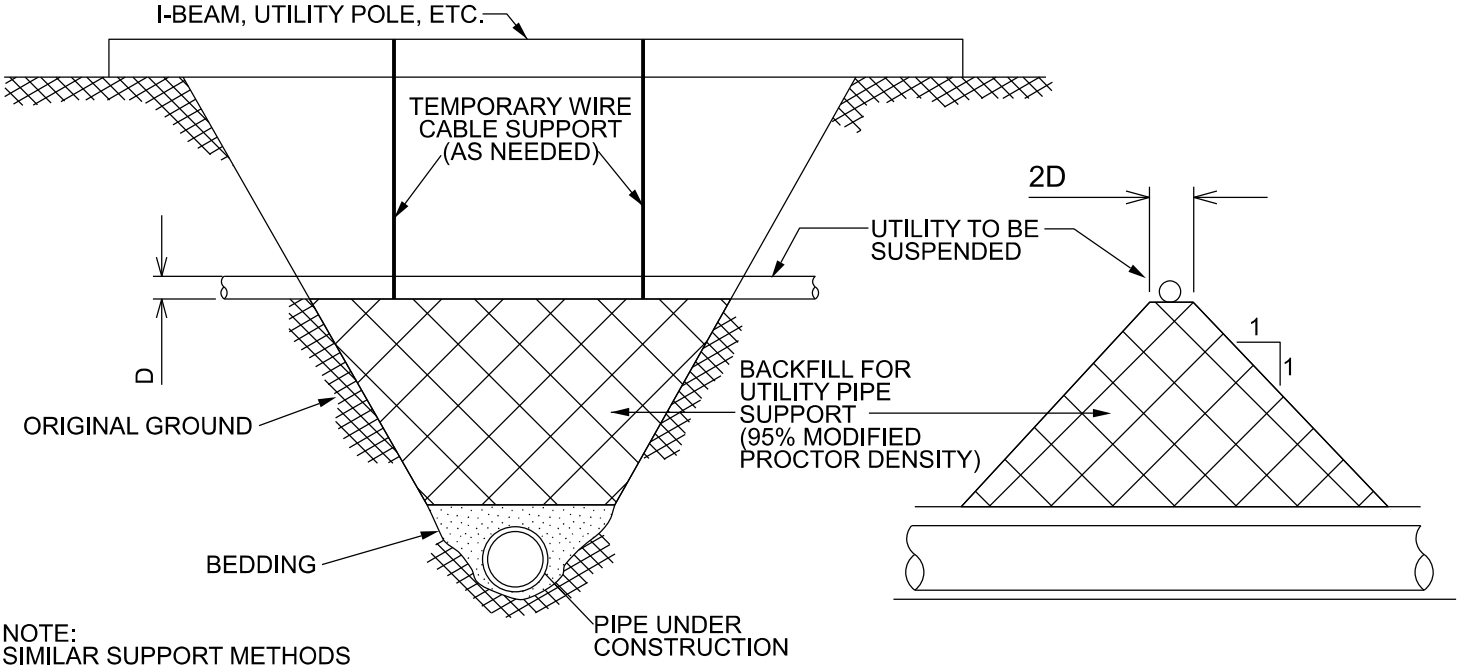
B. Root Treatment Equipment - The equipment used in chemical root treatment shall be in good working order. All measuring devices, such as flow-meters, shall be calibrated. The Engineer may require that the accuracy of gauges be checked if there is reason to suspect their accuracy.

C. Soaking

1. Soaking Agent - The chemical root control agent to be applied by soaking shall be formulated as recommended by the manufacturer of the agent.

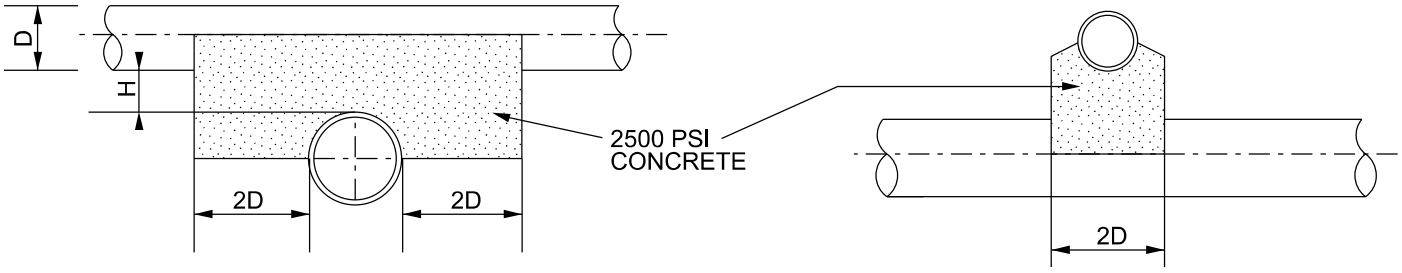
2. Application - A section of the line to be treated shall be filled with a freshly prepared and well-mixed solution containing no less than 1%, by volume, of the chemical agent. The section shall be fully charged for a soaking period of net less than 60 minutes with the solution being replenished as required to maintain the level of the solution above the upper end of the section under treatment and the concentration at 1%, by volume, of root control agent. Following the specified soaking period, the solution may be passed downstream to treat additional segments of lines. Additional root control agent shall be added as required to maintain the concentration of the solution at 1% and each segment shall be fully charged for not less than 60 minutes by the addition of solution as necessary.

SEWER DETAILS



NOTE:
SIMILAR SUPPORT METHODS APPLY TO UTILITIES PARALLELLING AND ABOVE THE SEWER UNDER CONSTRUCTION.

SPECIAL SUPPORTS FOR UNDERGROUND UTILITIES



SADDLES REQUIRED WHERE:

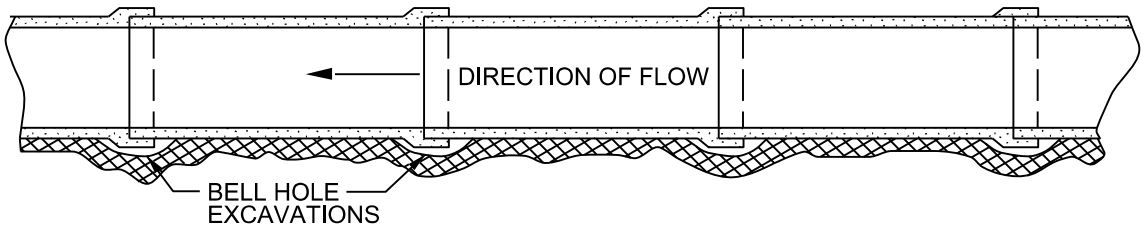
H < 3" FOR D < 15" DIA.

H < 6" FOR D = 18" THRU 36" DIA.

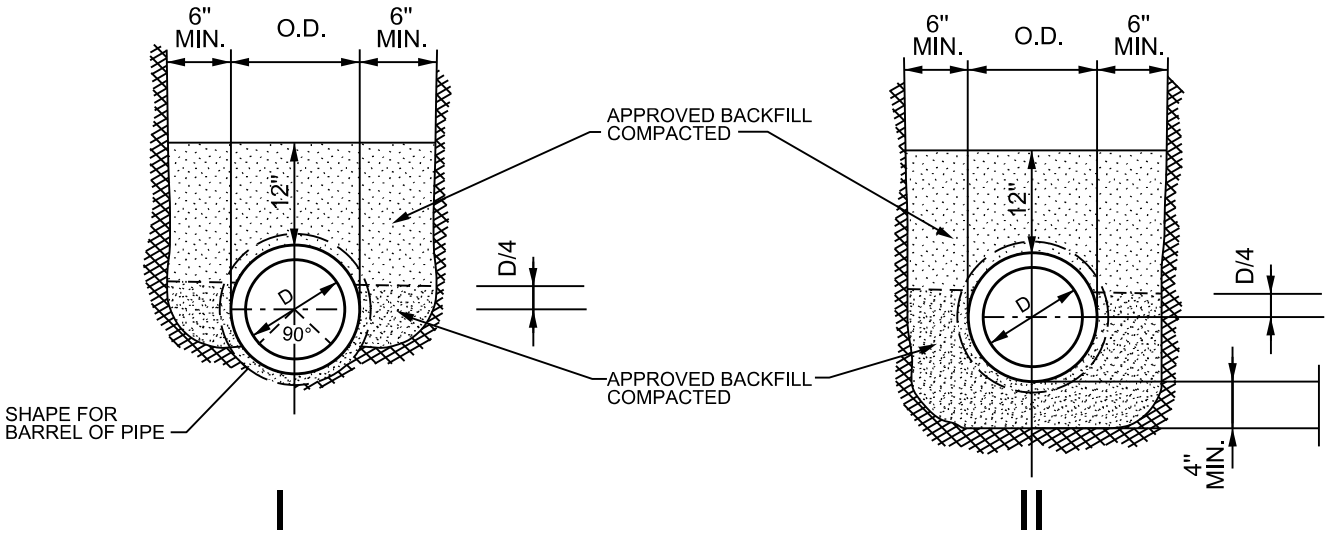
H <12" FOR D = 42" DIA. AND LARGER

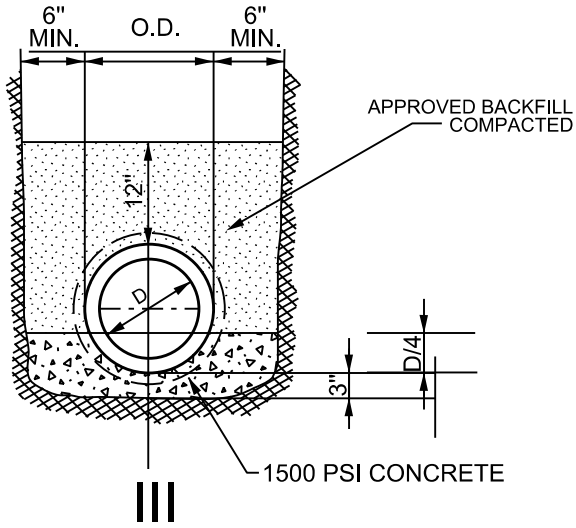
SADDLES ARE NOT REQUIRED FOR WATER MAIN OR GAS MAIN SERVICE PIPES 2" OR LESS IN DIAMETER.

PIPE SADDLES



EXCAVATION FOR BELLS





NOTES:

1. METHOD I SHALL BE USED IN AREAS OF UNCONSOLIDATED SOILS (SAND, GRAVEL, ETC.).
2. METHOD II SHALL BE USED IN AREAS OF CONSOLIDATED SOILS (CLAY, HARDPAN, ROCK, ETC.).
3. METHOD III SHALL BE USED IN AREAS AS NOTED ON THE PLANS.

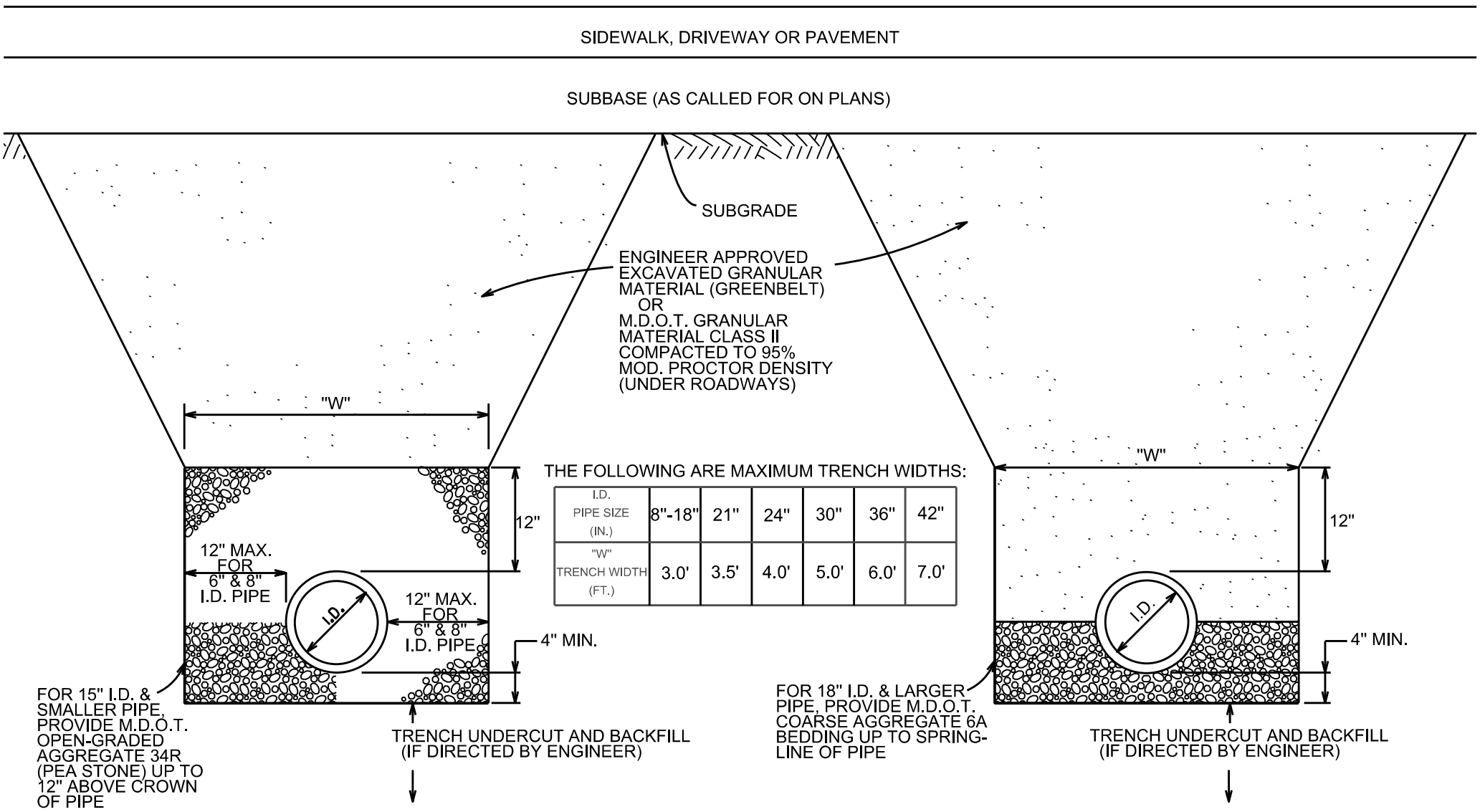
ALL BACKFILL INDICATED SHALL BE HAND COMPACTED TO 95% MODIFIED PROCTOR DENSITY.

REFER TO TRENCH DETAILS FOR MAXIMUM TRENCH WIDTHS.

METHODS OF LAYING SEWER PIPE

SD-4

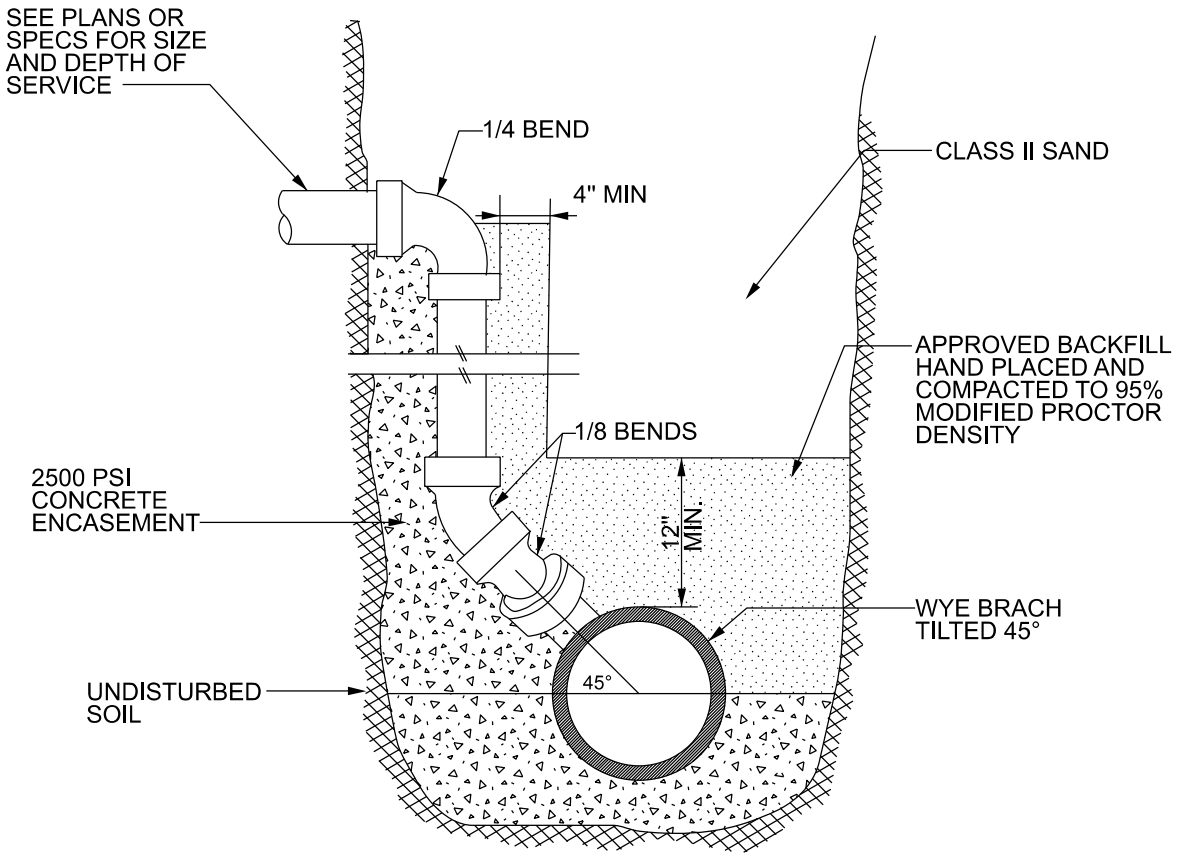
SEWERS



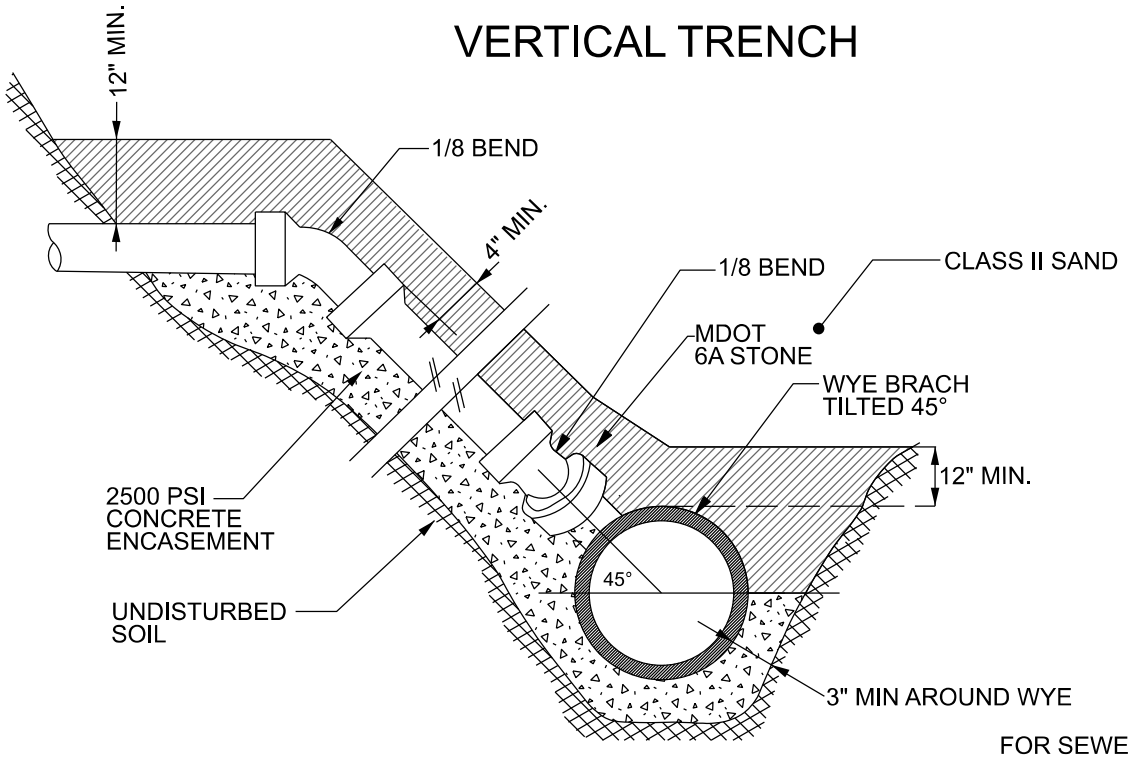
SEWER TRENCH FOR 15" I.D. & SMALLER PIPE

SEWER TRENCH FOR 18" I.D. & LARGER PIPE

SEWER TRENCH DETAILS



VERTICAL TRENCH



SLOPING TRENCH

FOR SEWERS 18" OR LESS, A "Y" SADDLE MAY BE USED IF THE OUTSIDE DIA. OF THE TAP IS LESS THAN ONE HALF THE DIA. OF THE SEWER BEING TAPPED.

STANDARD RISER DETAILS

(REQUIRED ONLY IF DEPTH TO TOP OF SEWER IS GREATER THAN 12 FEET)

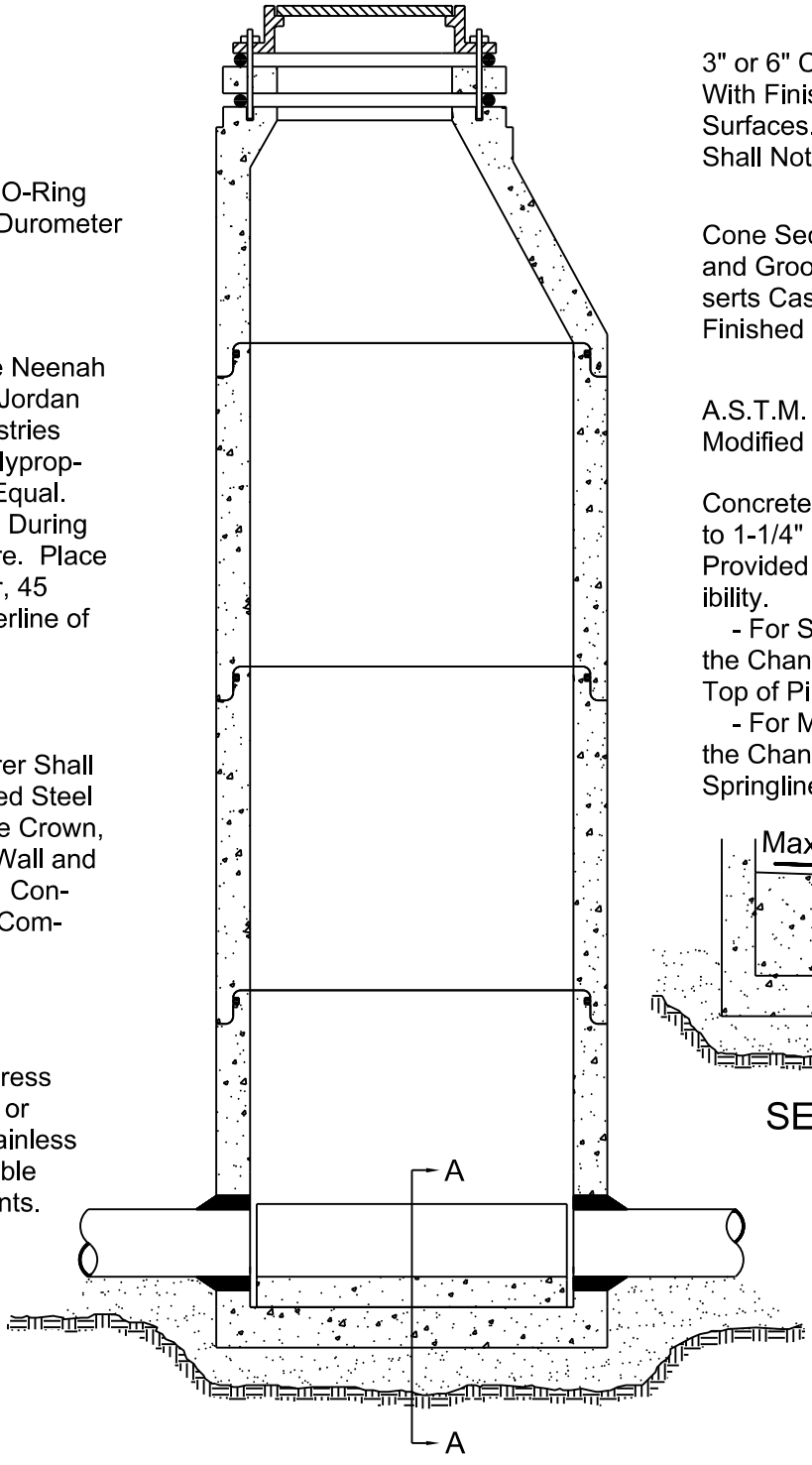
Waterproof Cast Iron Manhole Cover With Bolted Frame to be East Jordan No. 1040

1" Diameter Rubber O-Ring Gaskets. Minimum Durometer 20, Maximum 40.

Manhole Steps to be Neenah No. R-1980-E, East Jordan No. 8500, M.A. Industries PS-1 or PS-1-PF Polypropylene, or Approved Equal. Steps to be Installed During Manhole Manufacture. Place 16" Center to Center, 45 Degrees From Centerline of Sewer.

Manhole Manufacturer Shall Install 1/2" Galvanized Steel Pipe and Cap at Pipe Crown, Flush With Outside Wall and Extending 3" Inside. Contractor to Seal After Completion of Test.

Lock Joint Sleeve, Press Wedge II, Res-Seal, or Kor-N-Seal (With Stainless Steel Korband) Flexible Rubber Manhole Joints.



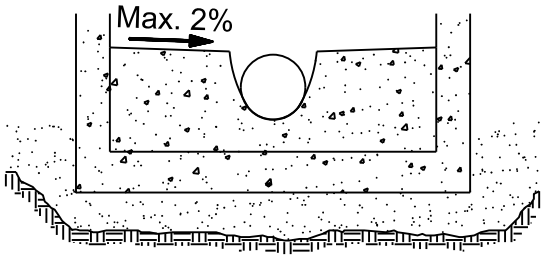
Four Cadmium Coated 5/8" Diameter Threaded Studs With 3/4"x2"x1/8" Thick Metal Washer, 3/4"x2"x1/16" Thick Neoprene Sealing Washer and Nuts.

3" or 6" Concrete Grade Rings With Finished Top and Bottom Surfaces. Maximum Adjustment Shall Not Exceed 15".

Cone Section With Modified Tongue and Groove Joints With Stud Inserts Cast in Place. Top to Have Finished Surface.

A.S.T.M. C478 Riser Sections With Modified Tongue and Groove Joints.

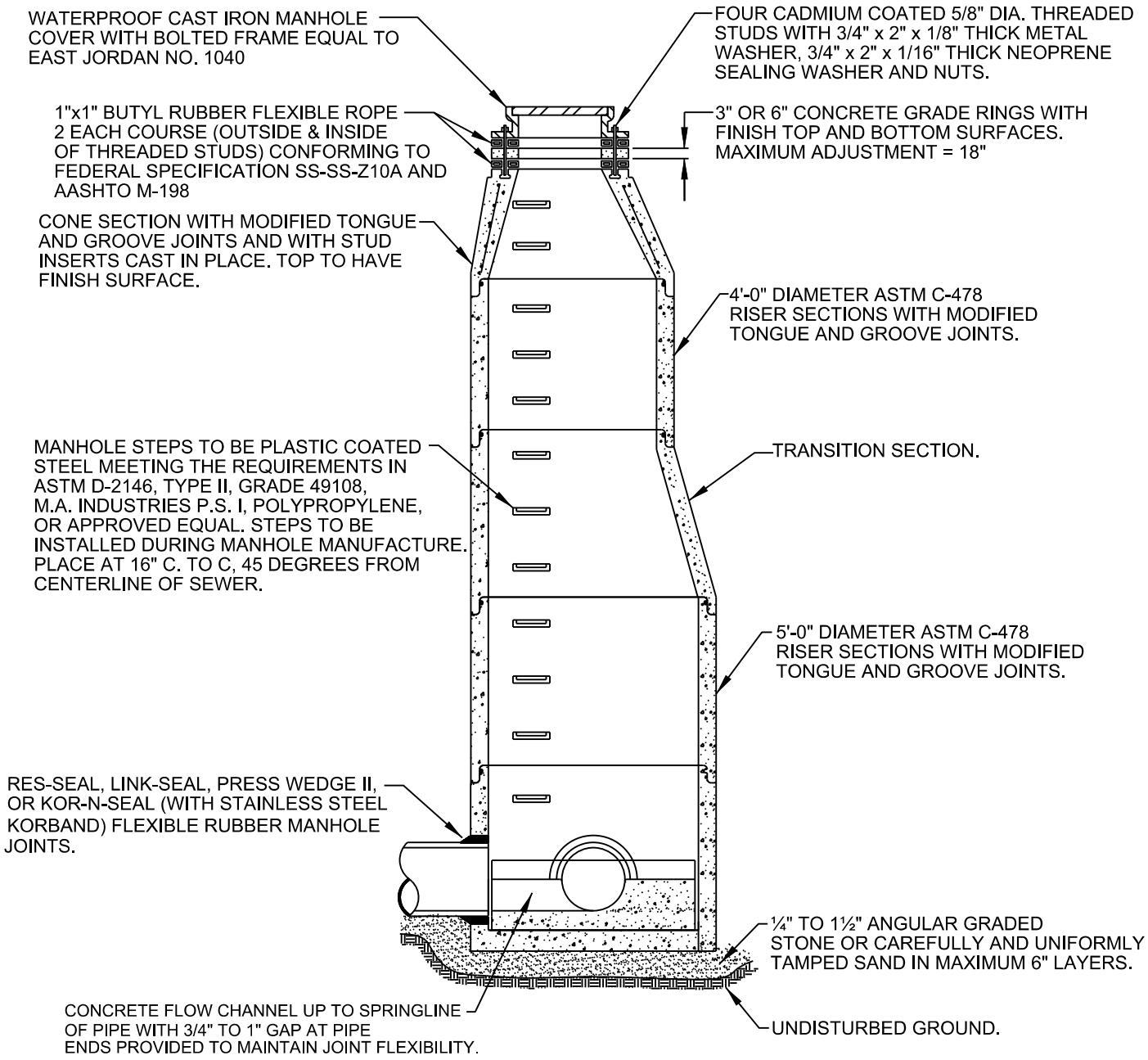
Concrete Flow Channel With 3/4" to 1-1/4" Gap at Pipe Ends Provided to Maintain Joint Flexibility.
- For Straight Thru Sewer, the Channel Should be Poured to Top of Pipe
- For Manholes With Bends, the Channel Should be Poured to Springline of Pipe



SECTION A-A

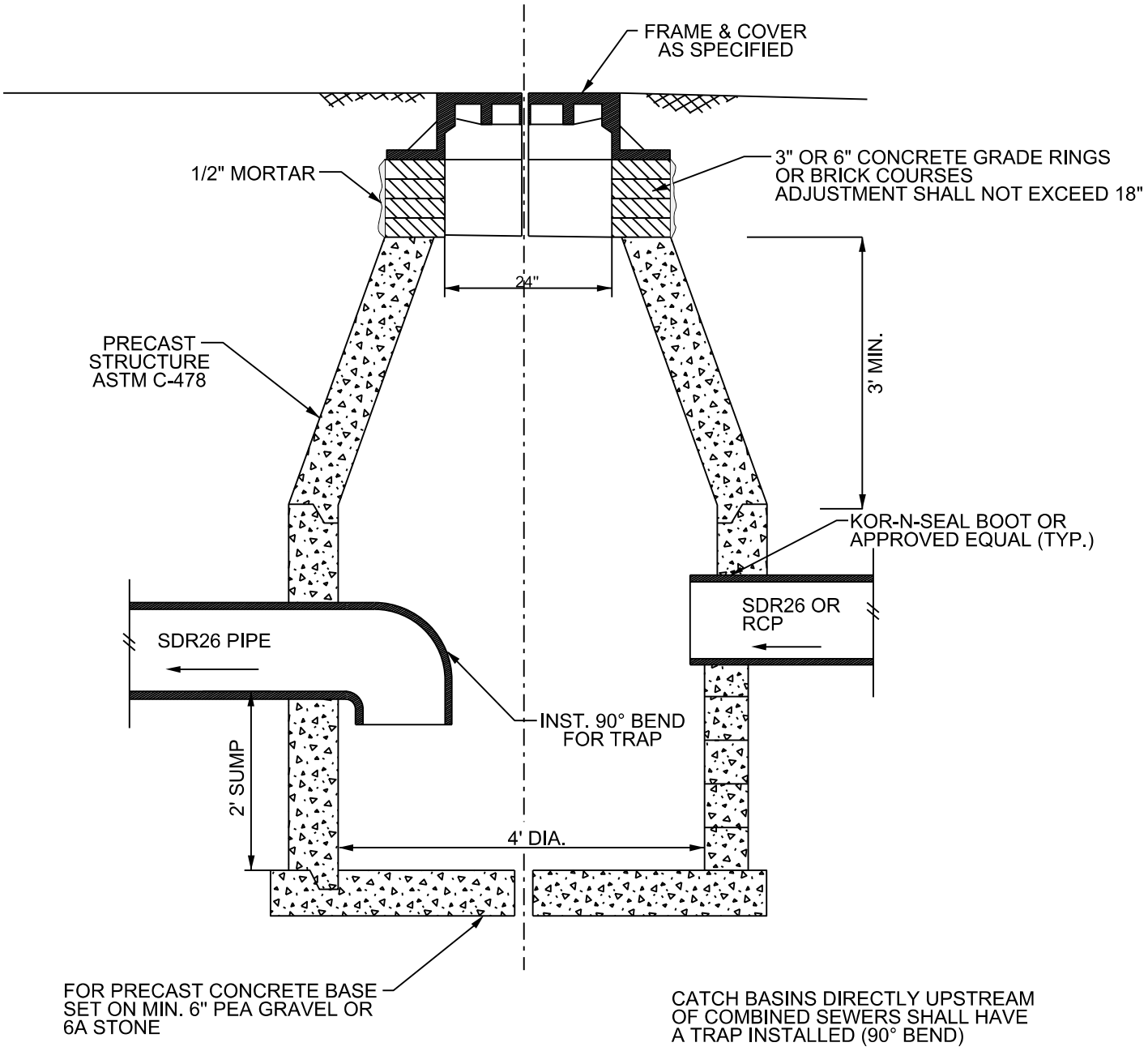
STANDARD 4 FOOT DIAMETER MANHOLE

ON SEWERS 8" THROUGH 18" IN DIAMETER

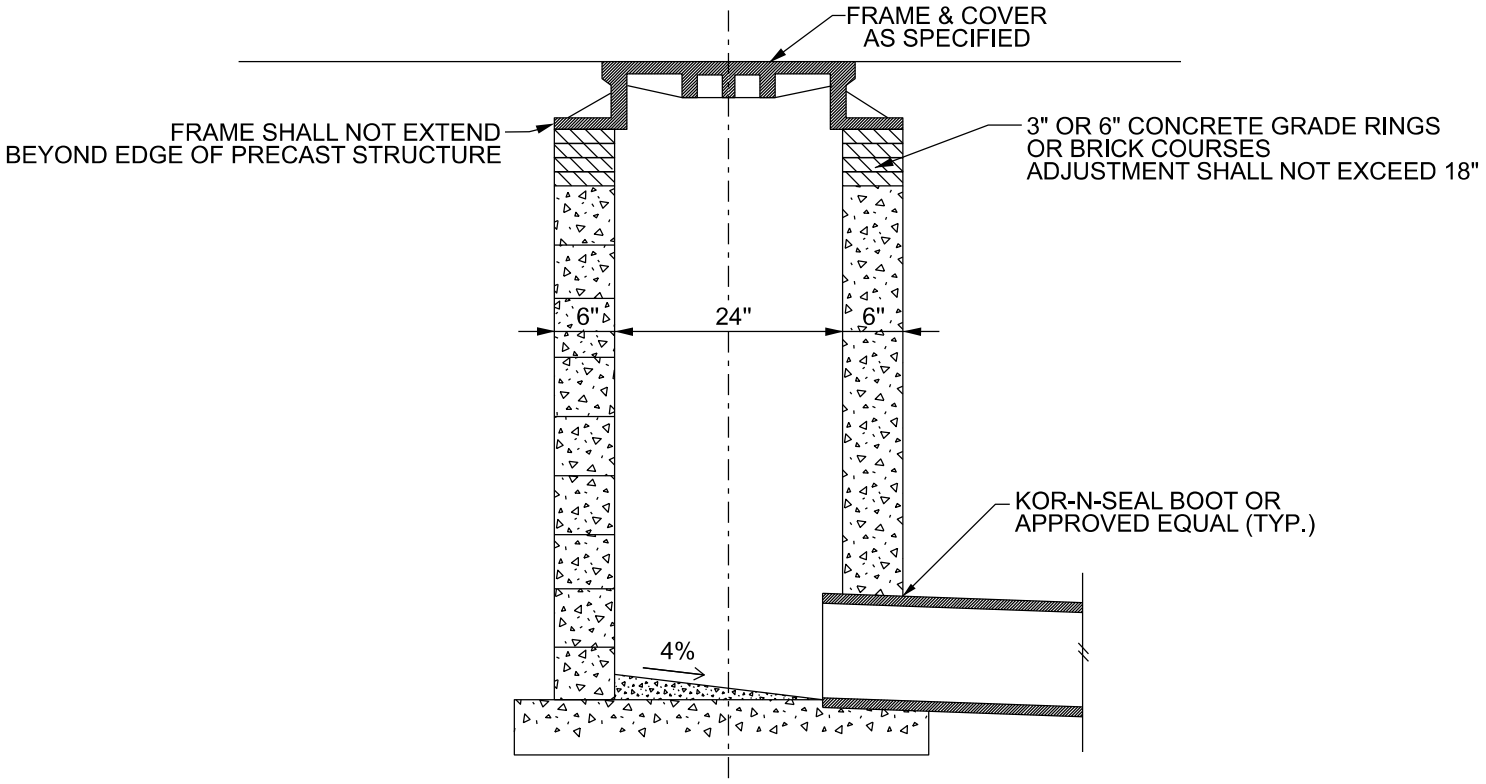


STANDARD 5 FOOT DIAMETER MANHOLE

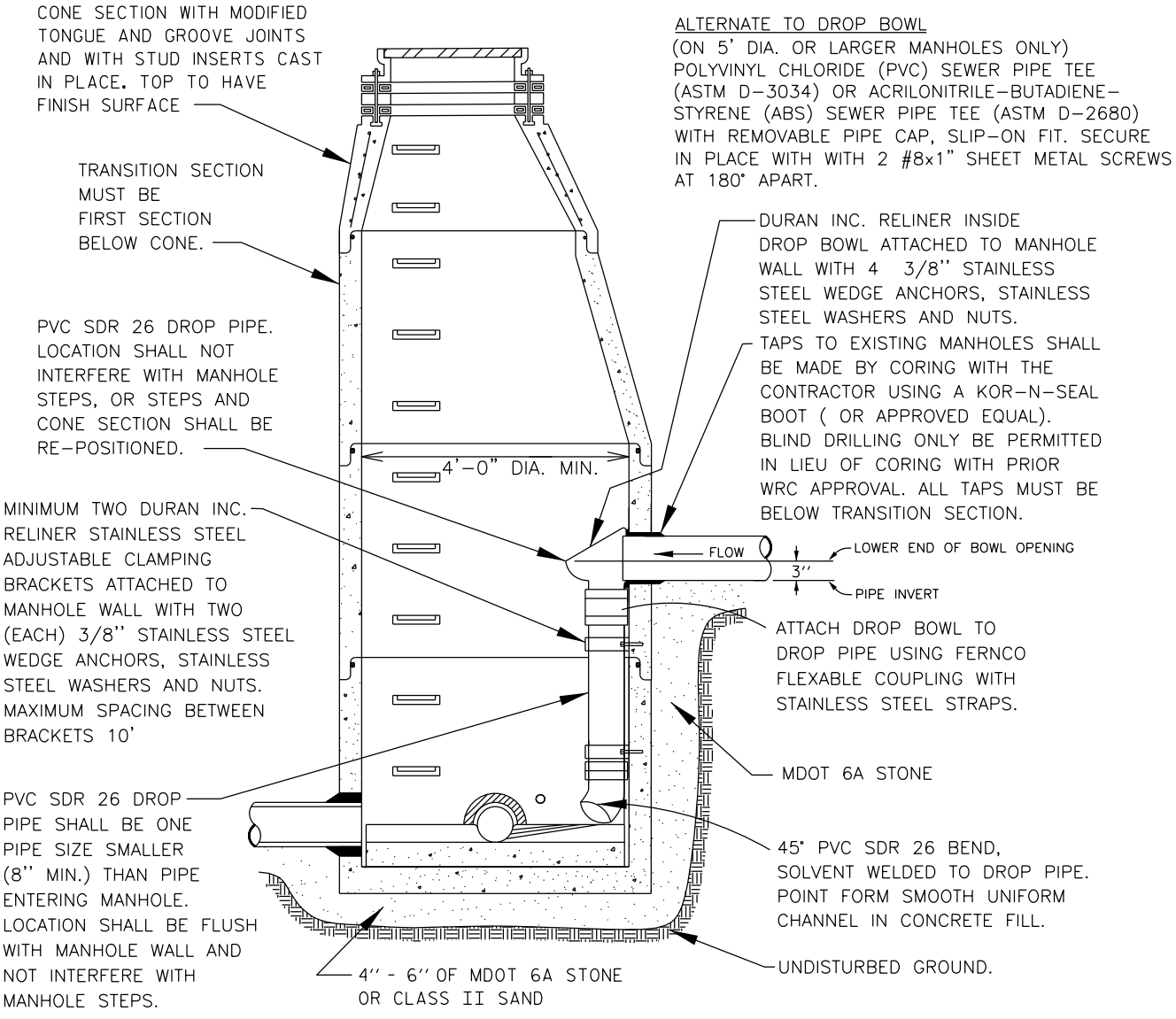
ON SEWERS 21" THROUGH 24" IN DIAMETER



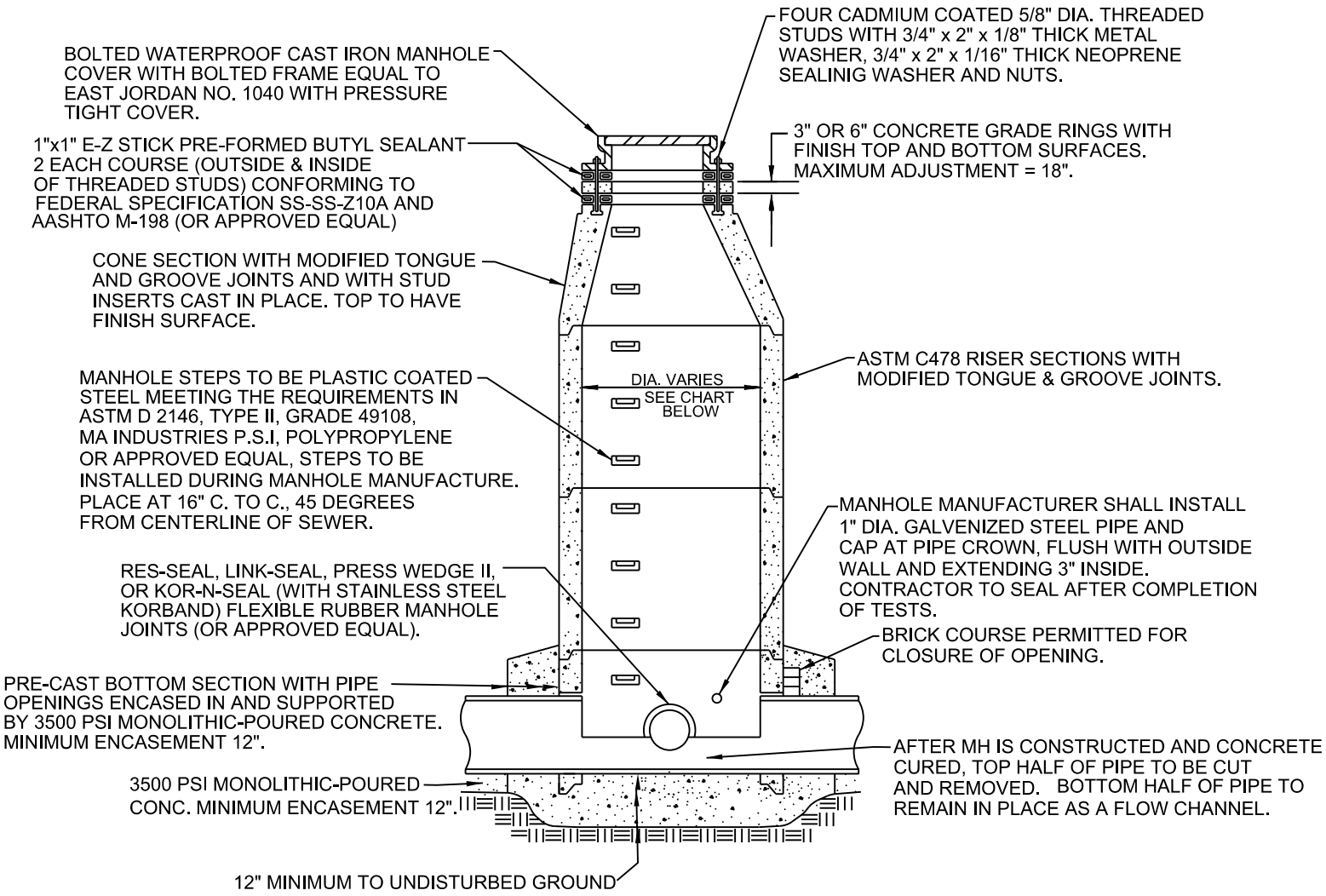
STANDARD CATCH BASIN



STANDARD STORM INLET



INTERIOR DROP CONNECTION *(FOR OVER 18" DROP)*

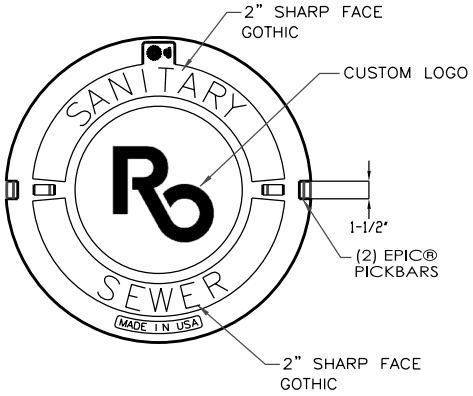


MANHOLE SIZING CHART

MANHOLE DIAMETER	MAX. PIPE SIZE FOR STRAIGHT THRU INST.	MAX. PIPE SIZE FOR RIGHT ANGLE INST.
4'	24"	18"
5'	36"	24"
6'	42"	36"
8'	60"	42"

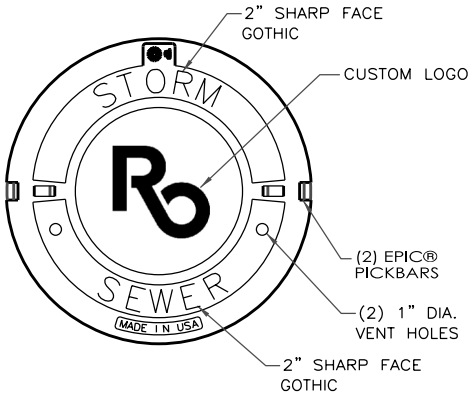
MANHOLE CONSTRUCTED OVER EXISTING SEWER

SAN. / COMB.
1040 TYPE A
EJ#001040183



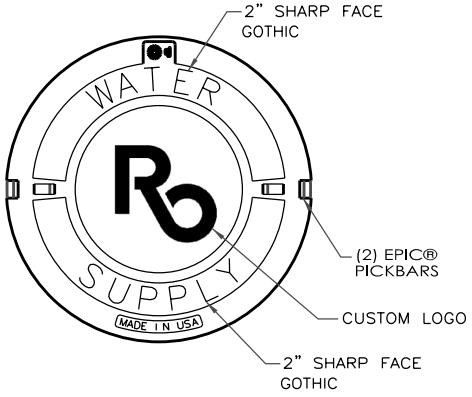
BOTTOM VIEW

STORM
1040 TYPE C
EJ#001040184



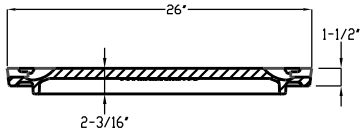
BOTTOM VIEW

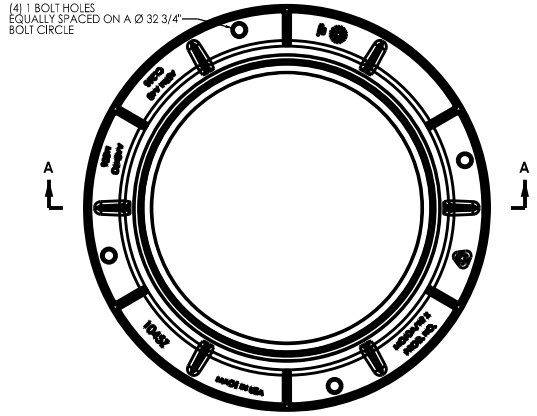
GATE WELL
1040 TYPE A
EJ#001040185

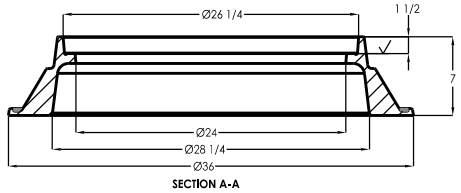


BOTTOM VIEW

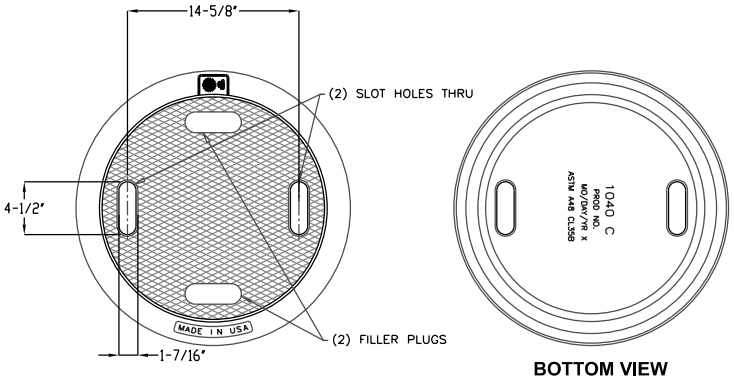
SECTION



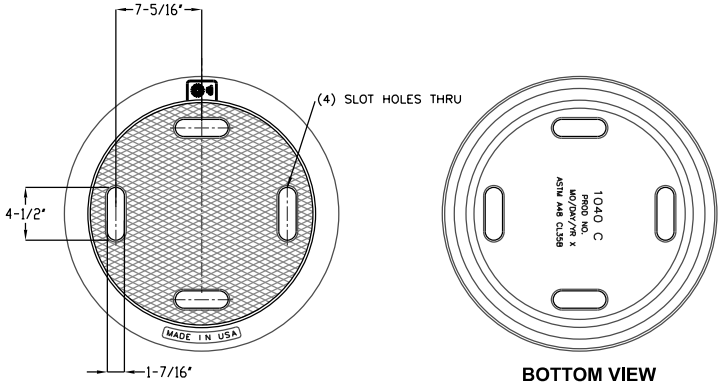




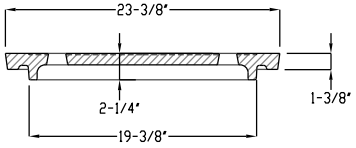
STANDARD 1045 FRAME
EJ#00104510



RESTRICTED CATCH BASIN 2-SLOT
1040 TYPE C
156 LB.
EJ#001040186



RESTRICTED CATCH BASIN 4-SLOT
1040 TYPE C
156 LB.
EJ#001040399

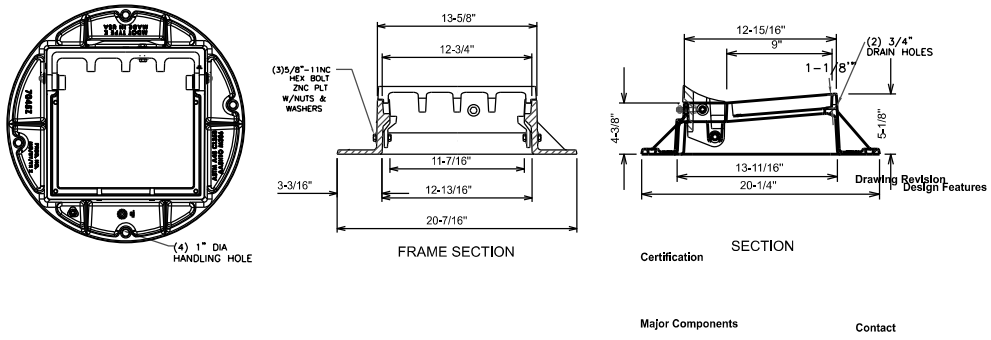


COVER SECTION

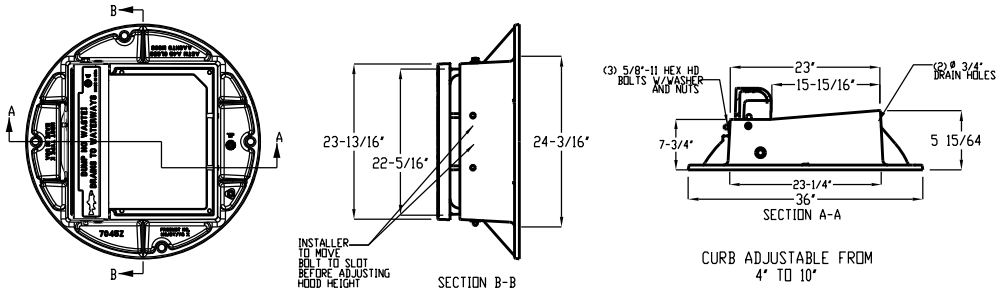
NOTE:
FOR GREENBELT CATCH BASINS, ACCEPTABLE COVERS INCLUDE:

BEEHIVE:
1040 TYPE 02
EJ#00104044

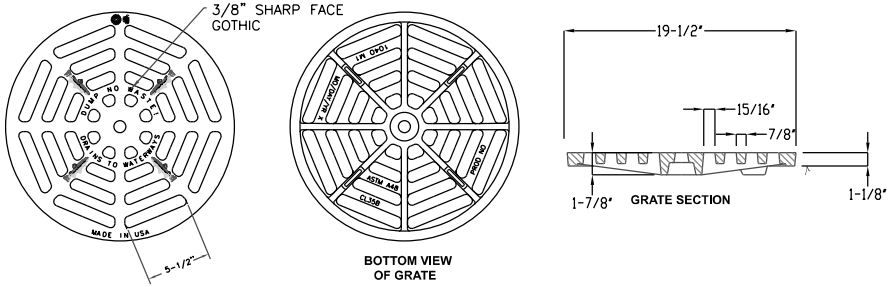
OVAL:
1040 TYPE N
EJ#00104042



CATCH BASIN GRATE
1040 TYPE M1 - DROPPED CURB
EJ#00706500



CATCH BASIN GRATE
1040 TYPE M1 - FULL CURB HEIGHT
EJ#00704500



RADIAL FLAT CB GRATE
1040 TYPE M1
EJ#00104030

GENERAL SPECIFICATIONS FOR WATER MAIN

1.00 GENERAL

1.01 WORK INCLUDED: The Contractor shall, unless specified otherwise, furnish all materials, equipment, tools and labor necessary to do the work required under the Contract, and unload, haul and distribute all pipe, castings, fittings, valves and appurtenances. The Contractor shall also provide barricades, guard and warning lights; install, test and chlorinate the pipe, castings, fittings, valves, hydrants and appurtenances.

The Contractor shall also furnish all equipment, tools, labor and material required to rearrange existing branch connections to main services, or rearrange existing services, conduits, ducts, pipe or other existing structures in accordance with the Contract documents, permit requirements and stipulations included herein.

1.02 SHUTTING OFF FOR CONNECTIONS: The existing water supply and fire protection systems shall not be disturbed, except as absolutely necessary, by the Contractor's operations. Special care shall be exercised where pipes are being removed and replaced with new lines. The Contractor shall carefully plan their work in order to avoid contamination and lengthy shutdowns of existing water mains.

The Contractor shall provide labor and tools to shut off the water for making connections, only if City crews cannot provide assistance. The Contractor shall not operate any water main valves unless the Engineer or Water Department employee is present at the shutoff location.

The Contractor shall meet with the Engineer and determine shutoff limits for affected property owners and **shall provide one day notice (24 hour notice)** prior to shutting off water.

The Department of Public Services and the Fire Department shall be notified when shutting off the water. They shall be informed of the limits of the shutoff, time duration, and which fire hydrants are affected.

1.03 CLEAN UP: Surplus water main materials and appurtenances furnished by the City shall be delivered by the Contractor to the City's warehouse or yard, and all surplus construction materials shall be removed from the site by the Contractor.

Main line - water main installation shall be limited to single runs of pipe that can be valved off. Clean-up shall be done prior to or concurrent with installing the next pipe section between valves.

Clean-up shall include:

A. Removing and hauling all excess fill, broken concrete, miscellaneous debris and other material generated by the project to a landfill approved by the City.

B. Obtaining rough grade in all lawn areas in preparation for lawn restoration.

C. Watering street pavement with hoses from fire hydrants and then sweeping with a mechanical pick-up type street cleaner approved by the Engineer.

D. Sweeping public sidewalks.

2.00 MATERIALS

2.01 GENERAL: Water main materials furnished by the Contractor shall conform in all respects to the following specifications. Where reference specifications are used, they shall be considered as referring to the latest edition. Unless otherwise indicated, materials furnished by the City will also conform to these specifications. All pipe, regardless of material, shall be full diameter as called for in the Proposal.

All water main pipe, valves, hydrants, fittings and associated materials shall be manufactured in the United States, unless authorized by the City Engineer.

2.02 DUCTILE IRON PIPE: The ductile iron pipe to be furnished, delivered and installed under this specification shall conform in all respects with the requirements of the current edition of American National Standards Institute "Ductile-Iron-Pipe, Centrifugally Cast in Metal or Sand-Lined Molds for Water or Other Liquids" (ANSI A21.51), or American Water Works Association (AWWA C151), except as may otherwise be specified herein.

All sizes of ductile iron pipe shall be of a class conforming to the dimensions shown in the following table:

Size Nominal Inside Diameter (in)	Outside Diameter (in)	Pipe Barrel Thickness (in)	Thickness Class
4	4.80	0.35	54
6	6.90	0.37	54
8	9.05	0.39	54
12	13.20	0.43	54
16	17.40	0.46	54
20	21.60	0.51	55

The manufacturer shall furnish a sworn statement with ANSI/AWWA C151/A21.52, stating that the pipe furnished meets the forementioned.

The pipe shall be lined with a cement mortar lining in accordance with the requirements of the current standard for "Cement Mortar Lining for Cast-Iron Pipe and Fittings for Water" (ANSI/AWWAC104/A21.4). The lining shall be double thickness.

2.03 HIGH DENSITY POLYETHYLENE (HDPE) PIPE: HDPE pipe shall only be used when approved in writing by the Engineer.

HDPE pipe and fittings shall be designation DR 11 pressure class 160 pipe in sizes 8 inch through 20 inches in diameter, color striped blue, and in conformance with requirements of AWWA C906 Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 inch and larger for Water Distribution. HDPE pipe and fittings shall be made from resin meeting requirements of Plastic Pipe Institute (PPI) as PE4710. Resin material shall meet or exceed the requirement of ASTM D3350 and the cell classification of 445574C. Refer to PPI MA-03 “Model Specifications for PE4710 Buried Potable Water Service, Distribution and Transmission Pipe and Fittings”.

Pipe shall have a manufacturing standard of ASTM F714. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

HDPE pipe and fittings shall be of good quality and strength and be homogenous throughout, with inside and outside surfaces being semi-matte to glossy in appearance and free of sticky or tacky material. HDPE pipe and fittings shall be free of blisters, cracks, cuts, foreign inclusions, holes, nicks, significant scratches, voids, and other defects that may affect overall integrity of HDPE pipe and fittings. HDPE pipe or fittings having any indication of cracking or crazing inside or outside shall be rejected. HDPE pipe shall be straight and true circle in section with concentric inner and outer surfaces. Pipe installation must comply with ASTM D2321.

HDPE pipe shall be assembled and joined at the site using the fusible (butt-fusion) method to provide a leak proof joint in accordance with the current Plastic Pipe Institute (PPI) handbook. Threaded or solvent-cement joints and connections are not permitted. Butt fusion fittings shall be in accordance with ASTM D3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabricated from HDPE pipe conforming to this specification. All fittings shall be pressure rated to provide a working pressure rating no less than that of the pipe. The fitting shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, voids, or other injurious defects.

Fusing shall be accomplished by personnel certified as fusion technicians by the manufacturer of the H.D.P.E. pipe and/or fusing equipment. Refer to ASTM F3190, ASTM F1290, PPI publications MAB-01 and MAB-02 for recommended training.

Tracer wire shall be designed specifically for detecting buried utilities. Tracer wire for open cut installation shall be minimum of 12 AWG copper wire, solid, coated with a blue colored minimum 30 mil high molecular weight polyethylene insulation (HDPE or HMWPE). Tracer wire for trenchless water main shall consist of minimum (2) wires or as shown on plans and shall be minimum 12 AWG copper clad steel core wire, solid, with a blue 45 mil HDPE insulation. Provide manufactured connectors that are rated for direct burial, have a dielectric gel and are sealed.

2.04 **CAST IRON PIPE**: Cast iron pipe is no longer allowed on any new installations in the City of Royal Oak. However, there is considerable existing cast iron water main within the City that a new installation may be required to connect to. Be aware this existing cast iron pipe may be oversized or out of round. A DUO-Sleeve or coupling shall be used for the connection of ductile iron pipe to existing cast iron pipe. Refer to pages WD-18 through WD-21 for approved couplings.

If existing lead joints are exposed when making a connection, the joint shall be cut-out and removed.

2.05 **ASBESTOS-CEMENT PIPE**: Asbestos-cement is not allowed for new water main installations within the City of Royal Oak, however, there are some existing runs of pipe within the City.

2.06 **FITTINGS**: As follows:

ANSI/AWWA C153/A21.53-84 - American National Standard for Ductile-Iron Compact Fittings, 3-inch through 12-inch
ANSI/AWWA C111/A21.11-85 - American Standard for Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

The standard size for ductile iron and gray iron fittings is 3 through 48 inches for water main. Working pressure rating shall be 350 p.s.i.

A. For Ductile Iron:

All fittings and glands shall be ductile iron with the exception of oversize solid sleeves which shall be gray-iron. All couplings used to join water main shall be of the solid sleeve type. If the pipe is oversize, special oversized solid sleeves shall be used. No Dresser style solid sleeves shall be allowed. All bolts shall be Cor-Ten.

The City of Royal Oak's standard for fittings is the Tyler Union line of Mechanical Joint fittings.

Substitutions shall be approved by the Engineer in writing prior to use on the project and be equal to or greater than the equivalent Tyler fitting for flange and wall thickness.

B. For HPDE Pipe:

HDPE fittings shall conform to ANSI/AWWA C906 standards and be made of PE4170 with a minimum cell classification of 445574C.

Butt fusing molded fittings shall meet the standard of ASTM D3261 and fabricated fittings shall meet the standard of ASTM F2206.

Electrofusion fittings (includes all couplings and fittings) shall be made of HDPE material with minimum of PE4170 and the cell classification of 445574C. All electrofusion fittings shall a manufacturing standard of ASTM F1055and shall be installed according to the manufacturer's instructions.

MJ Adapters shall be PE4710 with a minimum cell classification of 445574C and meet the standard of ASTM D3261.

Mechanical fittings shall be designed to restrain and to prevent pull-out or rotation. Internal stiffeners shall be used with all mechanical compression fittings. The internal stiffener shall be made of ASTM A204 type 304 stainless steel and shall be tapered fixed diameter type or split-ring type with wedge insert. Fixed diameter stiffeners shall not be cut or clipped.

2.07 **VALVES**: Valves shall be ANSI/AWWA C500-86 solid wedge non-rising stem (**E.J. series MJ**) with mechanical joint ends as shown in Water Main Details sheets. Valves shall be manufactured as **right hand to open** when operating nut is turned in a **clockwise direction**.

All gate valves with operating nuts at a distance greater than five (5) feet below ground surface shall be provided with a stainless steel stem extension and shall be included in the price of the valve. The length of the extension stem shall reach within five (5) feet from the ground surface when an extension stem is used, it shall be held in place by an

extension stem guide suitably fastened to the wall of the road box or gate well. The stem extension shall be approved by the Engineer prior to installation

2.08 **HYDRANTS**: Fire hydrants shall be East Jordan **Model 5-BR-250 - WaterMaster** and meet the latest revisions of AWWA Standard C502. The hydrant shall be two way design having 3 ¾" Detroit FD D Dome Only and 5" Harrington Storz D Dome pumper nozzles in accordance with the City of Royal Oak Standard as described on page WD-10 and WD-10 b.

New hydrants are to be Rustoleum Industrial 5A271 Federal Safety Red.

2.09 **TYPE OF JOINTS**: As follows:

A. Rubber joints shall be similar to U.S. Pipe "Tyton Joint or "Super Bell Tite" for ductile iron pipe. Two bronze wedges per unit shall be used to provide electrical continuity.

B. Fittings, valves and hydrants shall be mechanical joints in accordance with (a) above unless specified otherwise in the Project Specifications. Bolts and nuts for Mechanical Joints shall be of high strength low alloy steel conforming to the characteristics listed in ANSI/AWWA C11/A21.11. All bolts and nuts shall be Cor-Ten t-bolts with Xylan coating or equal.

C. HDPE pipe joints shall be assembled and joined at the site using the fusible (butt-fusion) method to provide a leak proof joint.

D. Fittings for copper water services shall be flared type. Soldered joints shall not be used where pipe is buried.

2.10 **VALVE BOXES**: Valve boxes shall be of good quality cast iron and of the three-sectional type as shown in the Water Main Details. The center sections shall be a minimum of 5 inches inside diameter. The base section shall be large enough to fit over the valve bonnet. The upper section shall be arranged to screw down on the adjoining lower section and shall be full diameter throughout. Valve boxes shall be provided with cast iron lids or covers. Lids or covers shall be marked with the word "WATER". The overall length of valve boxes shall be sufficient to permit the top to be set flush with the established pavement or ground surface grade.

Gate valve adaptors shall be provided to keep valve in center of gate box. Refer to Water Main Details.

2.11 **MISCELLANEOUS**: As follows:

A. Copper pipe shall be in accordance with ASTM Spec. B88-55 "Type K", or Federal Spec. WW-T-799 "Type K".

B. Corporation stops shall be Mueller #H-15000N, or Engineer approved equal.

C. Saddles- 1 ½ inch and 2 inch - shall be Mueller BR2S and BR2W series bronze service saddles-double strap with 304L stainless steel straps, or Engineer approved equal.

D. Curb stops shall be Mueller #H-15204N, #B-25209N, or Engineer approved equal.

E. Curb boxes shall have stainless steel rods and shall be:

McDonald Model 5602 or Mueller H-10334 for 1" water services
McDonald Model 5603 or Mueller H-10308 for 1 ½" water services

McDonald Model 5603 or Mueller H-10310 for 2” water services
or Engineer approved equal

F. Service fittings or reducers for service connections shall be:

1. Mueller #H-15400N, or Engineer approved equal, for copper tube nut by copper tube nut, or Mueller #H-15403N for compression connection.
2. Mueller #H-15480N, #H-15485N and #H-15490N for straight, 45˚ bend and 90˚ bend coupling thread by copper tube nut, respectively, or Engineer approved equal.
3. Mueller #H-15505N and #H-15513N for straight & 90˚ bend extra strong lead flange by copper tube nut, respectively or Engineer approved equal.
4. Mueller #H-15428N or #H-15429N for straight male coupling from copper to iron, or Engineer approved equal.
5. Mueller #H-15062N & H-15068N for straight & 90˚ bend female copper service thread by copper tube nut, respectively, or Engineer approved equal.

G. Stainless steel repair clamps shall be FS Style Repair clamps as produced by the Ford Meter Box Company, Inc., or approved equal. Repair clamps shall be constructed of Grade 18-8, Type 304 stainless steel and with 5/8" stainless steel bolts with heavy hex nuts per ASTM A193 and ASTM A194. The nut threads shall have special lubricating coating to prevent galling. The repair clamp shall be furnished with a diagonal gridded rubber gasket consisting of SBR compounded for water service meeting ASTM D2000. The gasket shall provide 360-degree circumferential sealing support and will have a 16-gauge, 1/4 hard stainless steel armor, vulcanized into the gasket to span the gap between the ends of the repair clamp band. The bolts will be permanently affixed to the repair clamp by means of a stainless steel weld.

2.12 **DISPOSITION OF DEFECTIVE MATERIAL**: All material found during the process of the work to have cracks, flaws or other defects will be rejected by the Engineer. All defective materials furnished by the Contractor shall be promptly removed from the site by the Contractor. Any material furnished by the City and found defective shall be set aside by the Contractor and removed from the site by the City.

3.00 RESPONSIBILITY FOR MATERIAL

3.01 **MATERIAL FURNISHED BY THE CONTRACTOR**: The Contractor shall be responsible for all material furnished by them and shall replace, at the Contractor’s own expense all such material found defective during the life of the Contract.

3.02 **MATERIAL FURNISHED BY THE CITY**: The Contractor's responsibility for materials furnished by the City shall begin at the point of delivery thereof to the Contractor. Materials already on the site shall become the Contractor's responsibility on the day of award of the Contract. The Contractor shall examine all materials furnished by the City at the time and place of delivery to them and shall reject all defective material. Any material furnished by the City and installed by the Contractor without discovery of such defect will, if found defective prior to final acceptance of the work, be replaced with sound material by the City. The Contractor, however, shall at their own expense, furnish all supplies, labor and facilities necessary to remove such defective material and install the sound material in a

manner satisfactory to the Engineer. The Contractor's unit prices will be assumed to include an allowance for this responsibility.

3.03 **STORAGE**: The Contractor shall be responsible for the safe storage of all materials furnished by or to them and intended for this work. Interior of pipe and other materials shall be kept free from dirt and foreign matter. Pipes shall be stacked in safe rows / levels and properly secured against collapse. Height of stacking shall not exceed four feet. Valves and hydrants shall be stored so that they will drain and be protected from damage by freezing. The Contractor shall not store or place materials on private property. The Contractor shall not store or place materials in City parks without obtaining written permission from the Engineer. Fencing of stored materials may be required as determined by the City.

4.00 HANDLING MATERIAL

4.01 **HANDLING**: Pipe, fittings, valves, hydrants and appurtenances shall be loaded and unloaded so as to avoid shock or damage either to the castings, or to the pipe, or pipe coating, or pipe lining. Under no circumstances shall such material be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

4.02 **PIPE COATING AND LINING**: The pipe shall be lined with a cement mortar lining in accordance with the requirements of the current standard for "Cement Mortar Lining for Cast-Iron Pipe and Fittings for Water" ANSI/AWWA C104/A21.4. The lining shall be double thickness. If any part of the lining or coating is damaged, the repairs shall be made by the Contractor at their expense in a manner satisfactory to the Engineer.

5.00 ALIGNMENT AND GRADE

5.01 **GENERAL**: The water mains shall be laid and maintained to the required lines and grades with fittings, valves, and hydrants at the required locations. Valves and hydrants shall be set plumb.

A minimum horizontal alignment separation of 10 feet must be maintained between the sanitary/storm sewer and all water mains. The distance shall be measured edge to edge. If this is not feasible, the water main shall be installed with at least 1.5-foot vertical and horizontal clearance from all sewers, and shall be installed within a separate trench, upon the prior authorization of the Engineer.

5.02 **DEVIATIONS**: Wherever an obstruction, not shown on the plans, is encountered during the progress of the work and interferes to such an extent that an alteration in the plan is required, the Engineer shall be notified at once and shall make such changes in the plans as they deem necessary. If the change in plans results in a change in the amount of work required of the Contractor, such change will be paid for. Deflections for obstructions, if necessary, shall be governed by allowable limits in Article 6.

5.03 **DEPTH OF PIPE**: If no cover or grade is shown on the plans, the top of the pipe shall be placed five and one half feet (5.5') below the final surface of the ground, except where abrupt changes occurring the surface of the ground. High points in the pipe line shall be avoided in intersections and at crossings.

When located under pavement, the top of the pipe shall be laid five and one half feet (5.5') below the lowest grade at the gutter line. Variations in the depth of cover as shown on the plans may be made only on written order of the Engineer.

5.04 **PIPE CLEARANCE**: Water main installation shall maintain 1.5-foot minimum vertical clearance when crossing existing sanitary and storm lines as directed by the Engineer.

5.05 **PIPE BEDDING**: Pipe bedding shall be 6 inches of compacted porous material having a maximum size of 1 inch when requested by the Engineer. Shape ditch bottom so that the entire length of pipe barrel is evenly supported once placed. A section not exceeding 12 inches in length may be disturbed in order to remove cable slings or chains used in handling pipe or for making up pipe joints. Wood blocks or earth mounds shall not be used under the pipe line for any purpose.

6.00 LAYING PIPE

6.01 **CLEANING PIPE AND FITTINGS**: As follows:

A. Existing Cast Iron Pipe - All lumps, blisters and excess coal tar coating shall be removed from the spigot end of the pipe, and shall be wire brushed, wiped clean and dry and free from oil and grease before the joint is made.

B. Existing Ductile Iron or Asbestos-Cement Pipes - Remove clay, sand or mud from the machined end of the pipe by using clean water or scrubbing with sand. Wipe excess water from end and allow to dry prior to assembling the joint. Oil or grease can be removed by wiping the surface with a suitable solvent.

6.02 **HAMMER TEST**: Cast iron fittings shall be inspected by the Contractor for defects and while suspended, be rung with a light hammer to detect cracks.

LAYING PIPE: Pipe shall be installed in accordance with the current "Standard for Installation of Ductile Iron Water Mains and their Appurtenances" (ANSI/AWWA C600).

Before lowering into the trench, each pipe shall be inspected for defects, and the pipe's interior for cleanliness and cleared of all dirt and foreign matter. Every precaution shall be taken to prevent foreign material and/or trench water from entering when the pipe is placed. During the laying operations no debris, clothing, tools, or other materials shall be placed in the pipe. When work is not in progress, open ends of pipe or fittings shall be tightly closed with approved watertight seals, well packed.

All ductile iron pipe, push on and mechanical joints, shall be laid to allow 1/8-inch or 1/4-inch clearance between successive lengths in order to provide for thermal expansion and contraction of the pipeline.

Ductile iron pipe shall be laid with bell ends facing in the direction of laying. After placing a length of pipe in the trench, 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 tamped under and each side of the pipe, except at bell holes. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimension to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space. Once in

place, new pipe sections shall receive two (2) brass wedges installed at the pipe joint to insure for electrical continuity.

6.04 **CUTTING 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 or lining, and so as to leave a smooth end at right angles to the axis of the pipe.

A. Cast Iron: Cutting shall be done with a roller or shear type cutter or abrasive disk for pipe sizes up to 20 inches in diameter. When machine cutting is not available for cutting pipe 20 inches in diameter or larger, the electric arc cutting method will be permitted, using a carbon or steel rod. Only qualified and experienced person shall be used on this work.

   The flame cutting of pipe by means of an oxyacetylene torch will **not** be allowed.

B. Ductile Iron and Asbestos-Cement: Cutting the pipe shall be done by hand saw, abrasive discs or with a special pipe cutting tool. All pipe cutting tools must be of the true cutting variety. Under no circumstances is the asbestos-cement pipe to be cut with a roller or shear type cutting tool.

6.05 **CUTTING-IN TO EXISTING WATER MAINS**: Cut-ins shall be made with line pressure on or off according to the Project Specifications. Existing pipe lines shall be adequately supported during the cut-in operations and prior to placement of backfill. Reaction backing shall be placed behind all cut-in fittings.

For existing asbestos-cement pipe: Cut-ins shall be made by machining cut ends in the field or by removal of a full length of pipe and installation of special machined lengths. After placing a length of pipe in the trench, it shall be lined up with the previous lengths and the joint made up. Pipe and fittings which do not allow sufficient uniform space for the joint shall be removed and replaced with pipe and fittings of proper dimension to insure such uniform space. The coupling shall be installed so that the final position of the pipe spigots is midway in the coupling.

For connecting HDPE pipe to ductile iron pipe or PVC pipe, connection shall be made by an adapter kit which includes HDPE bell mechanical joint fitting with stainless steel reinforcing collar, C-110 heavy body ductile iron gland ring, gasket and extra length T-bolts. Installation shall be made with mechanical joint restraining mechanism for ductile iron or PVC pipe. Adapter kit shall be installed according to manufacturer’s instructions.

The bedding may be disturbed for a distance of 12 inches to set joint assembly jacks, but the area disturbed must be thoroughly compacted prior to backfilling the pipe.

Prior to cutting existing pipe lines, the surface of the existing pipe shall be thoroughly cleaned by wire brushing and scraping. When cut-in is made under pressure, the existing pipe surface shall be washed down with a 4% solution of chlorine prior to installing the cutting-in tee. All fittings, pipe, valves, etc., used in the connection shall be swabbed out with a 4% or stronger solution of chlorine ("Roman Cleanser", "Clorox", etc.) during assembly. Care shall be exercised in order to prevent contamination of the existing water mains, and failure to comply with this requirement will necessitate chlorination of existing water mains at the Contractor's expense.

After connection is made, the Contractor shall drain sufficient water from the connection to effect removal of the chlorine solution.

The Contractor is advised that the dimensions of existing water mains may not allow use of standard mechanical joint fittings, since these water mains may be pit cast pipe, asbestos-cement pipe and / or in classes other than standard. All connections, fittings and reaction backing shall be included in the Contract. The Contractor shall install a 1 (one) foot thick bulkhead of brick and concrete in all abandoned water main. This work shall be considered in part of the Contract items of work.

6.06 **PERMISSIBLE DEFLECTIONS AT JOINTS**: Wherever it is necessary to deflect pipe from a straight line, either in a vertical or horizontal plane, to avoid obstruction or to plum valves and hydrants or where long radius curves are permitted, the amount of deflection allowed shall not exceed that shown in the following table:

Maximum Permissible Deflections

Ductile Iron: Push-on joints:

Diameter.	Maximum Permissible Deflection	Maximum Deflection per Length		Approx. Radius of Curve Produced by Succession of Joints	
		18' section	20' section	18' section	20' section
4"	5°	19”	21”	205’	230’
6"	5°	19”	21”	205’	230’
8"	5°	19”	21”	205’	230’
10"	5°	19”	21”	205’	230’
12"	5°	19”	21”	205’	230’
14"	3°	11”	12”	340’	380’
16"	3°	11”	12”	340’	380’
18"	3°	11”	12”	340’	380’
20"	3°	11”	12”	340’	380’
24"	3°	11”	12”	340’	380’

7.00 BORING

7.01 **BORING WITHOUT CASING**: This item of work shall consist of boring beneath the influence of driveways, trees and landscaped areas for the installation of the water main indicated on the plans. The work shall be performed at the locations shown on the plans or as directed by the Engineer.

The work shall be performed with an approved boring machine. The boring shall be performed without a sleeve, and the diameter of the auger shall be no more than four (4) inches greater than the outside diameter of the pipe to be installed. If unstable granular soils are encountered during excavation, the Engineer may direct the installation of a casing. Boring with a steel casing shall be made paid as described below.

All trees eight (8) inches in diameter or less, measured four (4) feet above the ground surface shall require a boring length of eight (8) feet. Trees over eight (8) inches in diameter shall require a boring length of one (1) foot for each inch of tree diameter. Boring

lengths shown on the plans are only approximate lengths, and lengths may vary in the field as directed by the Engineer.

The cavity between the outside of the pipe and undisturbed ground shall be sealed at both ends of the bore with 2,500 p.s.i. concrete a minimum of eight (8) inches thick. Payment for each bore shall be made by the linear foot of undisturbed ground directly above the bore.

7.02 **BORING WITH STEEL CASING**: This item of work consists of furnishing and installing various steel casing if the Engineer directs installation of a casing at any location where water main is placed by boring method. During boring operations, the auger shall not be advanced beyond the end of the casing.

The work includes cutting and welding sections of the casing as required and jacking the casing in place. If directed by the Engineer or indicated on the drawings, work shall also include strapping 4 x 4 timbers to the water main or sewer, filling voids between the pipe and casing with non-shrink grout to within 1 inch of the top of the casing, and bulkheading both ends of the casing. In addition, any cavity between the outside of the casing and undisturbed ground shall be sealed with 2,500 p.s.i. concrete with a minimum of eight (8) inches thick. The size of the casing shall be sufficient to safely contain the pipe diameter to be installed, and the work and materials to be furnished and installed as directed by the Engineer.

Payment for this item of work will be by the linear foot of steel casing installed as indicated on the Plans or as directed by the Engineer.

7.03 **HORIZONTAL DIRECTIONAL DRILLING:** Prepare a Project Work Plan (PWP) in advance of the pre-construction meeting which clearly defines the HDD installation in conformance with the requirements of the Contract Documents. The PWP shall at minimum contain access pit locations, earth retention systems, schedule, traffic control, equipment details, method to control line and grade, method of joining pipe, tracer wire installation, abandonment of pilot holes, dewatering plans, drilling fluid product information, and any other details to clearly outline the contractor's work plan.

HDD Equipment: The directional boring equipment shall consist of, at minimum:

1. A directional boring rig of sufficient capacity to perform the bore and pullback the pipe within the planned line and grade,
2. A boring fluid mixing and delivery system of sufficient capacity to successfully complete the drilling operation,
3. A guidance system to accurately guide boring operations, and
4. Trained and competent personnel to operate the system.

Boring rig shall consist of a hydraulically powered system to rotate, push and pull the specified product pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.

1. Anchor machine to withstand the pulling, pushing, and rotating pressure required to complete the drilling operation.
2. Hydraulic Power System
    a. Self-contained with sufficient pressure to power the boring operation

b. Free of Leaks

3. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.
4. Rig shall be grounded during boring and pull-back operations

The directional boring equipment must meet the minimum thrust/pullback rating, minimum rotary torque rating, and the minimum mud flow pumping capacity to facilitate installation of the product pipe per the contract drawings.

The guidance system must have the capability to locate and track continuously and accurately the drill head during the pilot bore, acceptable methods include:

1. Walkover
2. Wire Line
3. Magnetic Guidance System
4. Proven (non-experimental) gyroscopic probe
5. Owner approved equal

The guidance system shall have the ability to measure and provide information on the following:

1. Clock and pitch
2. Depth
3. Transmitter Temperature
4. Battery Status
5. Position (x,y)
6. Azimuth, where direct overhead readings (walkover) are not possible

The guidance system must have an independent means to ensure the accuracy of the installation. Contractor will demonstrate a viable method to eliminate accumulated error due to inclinometer (pitch or accelerometer). The guidance system shall be capable of generating a plot of the borehole survey for the purpose of an as-built drawing.

HDD Drilling Fluid: No drilling fluid shall be used that does not comply with environmental regulations. Drilling fluids shall be a mixture of clean water and bentonite clay. The fluid shall be inert and should remain in the bored tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill within the annulus of the pipe and tunnel.

The Contractor shall provide clean water for the mixing of drill fluid. The Contractor is responsible for locating a clean water source, and for transportation and storage of water.

Prior to Drilling: Verify horizontal and vertical location of all known utility crossings along the proposed bore path. Existing utilities within the path of the proposed horizontal directional bore, shall be “pot holed”, to determine the depth.

HDD Drilling Procedures: Evaluate the atmosphere in and around the project site to determine the presence of toxic or flammable vapors or lack of oxygen prior to performing any access pit excavations or beginning drilling operations.

The dewatering plan and method used by the Contractor, must be approved by the Owner, prior to commencing with the dewatering activity. When water is encountered, the Contractor must provide a dewatering system of sufficient capacity to remove water, keeping any excavations free of water until the backfill operation is in progress. The Contractor shall prevent ground movements caused by excessive dewatering and shall be responsible for any property damage resulting from the dewatering and drilling operations.

Rope off and cover all access pits when not active. Minimize the period of shutdown between work shifts for boring, reaming or product pipe installation operations (48 hours maximum).

Pilot Hole Boring:

1. Maintain the entry angle and pilot hole during the boring process at a curvature that does not exceed the allowable bending radius of the product pipe.
2. Advance the cutting head outside the influence of any roadway prior to ceasing the operation for the day.
3. Drill the pilot hole along the path shown on the plan and profile drawings to the following tolerances:
    a. Elevation: plus or minus 6 inches
    b. Alignment: plus or minus 6 inches
    c. Curve Radius: No curves will be accepted with a radius less than that shown on the drawings.
4. Alignment adjustments and restarts
    a. Follow the pipeline alignment as shown on the drawings, within the specifications stated.
        i. If adjustments are required, the Contractor shall notify the Engineer and Owner for approval prior to making the adjustments.
    b. In the event of difficulties at any time during boring operations requiring the complete withdrawal from the tunnel, the Contractor may be allowed to withdraw and abandon the tunnel and begin a second attempt at a location approved by the Owner and Engineer.
    c. The number of access pits shall be kept to a minimum.
        i. The equipment must be capable of boring and installing the water main in a continuous run without intermediate pits, of a minimum distance of 600 feet unless otherwise authorized by the Engineer.
        ii. The maximum length of any bore shall not exceed 1200 feet.
    d. Plot the actual horizontal and vertical alignment of the pilot bore hole at each edge of pavement and at intervals not exceeding 20 feet. Update this plot as the pilot bore is advanced

Installing Pipe:

1. After the pilot hole is completed, install a swivel to the reamer and commence pullback operations.
    a. Should pre-reaming of the tunnel be necessary, it shall be performed at the option of the Contractor, and at no additional cost to the Owner.
2. The reaming diameter shall not exceed 1.4 times the diameter of the product pipe being installed.

3. For product pipe diameters' greater than 20-inch, an intermediate pre-reaming is required before pulling the pipe into place.
4. The product pipe being pulled into the tunnel shall be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.
    a. Utilize pipe rollers, skates or other protective devices to prevent damage to the pipe, eliminate ground drag, reduce pulling force and reduce the stress on the pipe and joints.
5. Assemble required piping in a manner that does not obstruct adjacent roadways or public activities.
6. Tracer wire is required for all non-metallic pipe installations.
7. Drill path alignment shall be as straight as possible to minimize the frictional resistance during pullback and maximize the length of the pipe that can be installed during a single pull.
8. Pullback forces shall not exceed the allowable pulling forces for the product pipe.
9. The Contractor shall allow sufficient length of product pipe to extend past the termination point to allow connections to adjacent pipe sections or gate valves.
10. Pulled pipes will be allowed a minimum of 72 hours of stabilization prior to making tie-ins, unless otherwise indicated.
    a. This duration may be reduced or extended at the Owner's discretion based on the pipe material being installed or the length of the bore.
11. Temporarily seal pulled pipe ends with a cap until the connection is made permanent.

12. Do not remove the drilling fluid in the annular region outside of the pipe after completion of the pipeline installation. The drilling fluid is to remain in place to provide support for the pipe and the neighboring soil.

Drilling Fluid:

1. Utilize drilling fluid during drilling and back reaming operations.
2. Contain excess drilling fluids within a lined pit or containment pond, or trailer-mounted portable tank, until removed from site.
3. Dispose of excess drilling fluid and spoils in compliance with all relevant regulations, right-of-way, workspace requirements, and permit agreements.
    a. Dispose of excess drilling fluid and spoils at an approved location at no additional cost to the Owner.
    b. Transport all excess drilling fluid and spoils to the disposal site at no additional cost to the Owner.
    c. Transport excess drilling fluid and spoils in a manner that prevents accidental spillage onto roadways.
    d. Do not discharge excess drilling fluid and spoils into streets, manholes, sanitary or storm drain systems, other drainage systems, or waterways.
4. Drilling fluid returns caused by fracturing, formations, or any other means at locations other than the entry and exit points shall be minimized. The Contractor shall immediately clean up and dispose of any drilling fluid and spoils from return areas.
5. The Contractor shall provide mobile spoils removal equipment capable of quickly removing spoils from entry and exit pits and from return areas. This equipment must be present during all HDD operations to fulfill the disposal requirements previously described.

Field Quality Control:

1. Provide and maintain instrumentation which will accurately perform the following functions:
    a. Locate the pilot hole.
    b. Record coordinates referenced to the drilled entry point.
    c. Measure drilling fluid flow discharge rate and pressure.
    d. Measure pullback pressure.
2. Monitor potential heave or settlement at each shoulder point, each edge of pavement, the edge of each lane of pavement (or centerline for two lane roads), and otherwise at 50 foot intervals along the pipe centerline. Perform baseline survey one day prior to initiating this operation at each required monitoring location. Perform daily follow-up surveys at the monitoring points established in the baseline survey until the HDD operations are complete. Record all survey readings to the nearest one-hundredth (0.01) of a foot. Take digital photographs of the ground surface conditions prior to and after HDD operations. Stop HDD operations immediately whenever monitored points indicate a vertical change in elevation of ½ inch or more, or any surface disruption is observed. Immediately report the amount of settlement to the Owner's resident project representative or permitting agencies inspector.
3. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operations are encountered, notify the Owner and Engineer immediately. The Owner, Contractor and Engineer shall review the situation and jointly determine the feasibility of continuing drilling operations, making adjustments or switching to an alternative construction method if necessary.
4. Provide a tabulation of coordinates referenced to the drilled entry point of the pilot hole drilling to accurately describe the location of the pilot hole. Provide a log of the pullback pressures for each setup upon completion of the installation of each length of pipe.

8.00 JOINTING

8.01 MECHANICAL JOINTS: Soapy water may be used to lubricate the rubber gasket. The normal range of bolt torque to be applied to ¾ inch bolts is 60-90 foot-pounds. A torque limiting wrench shall be used to prevent overstressing of bolts.

If effective sealing is not obtained at the maximum torque of 90 foot-pounds, the joints shall be disassembled and reassembled after a thorough cleaning. Overstressing of bolts to stop leaks will not be permitted.

When tightening bolts, it is essential that the gland be brought up evenly toward the pipe flange, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket (uneven stresses in the glad ring may cause failure under pressure test stresses).

If there are any visible lead joints when connecting to an existing cast iron water main, they shall be cut out and replaced with ductile pipe.

8.02 **ROLL ON RUBBER JOINTS**: Roll on rubber joints ("Tyton Joint", "Super Bell-Tite", etc.) shall be installed according to manufacturer's directions. All field cut pipe shall have spigot end beveled with a grinder or file to the same dimensions as manufacturers standard spigot for joint being made. Field beveling will not be required on pipe joints at mechanical joint fittings. Brass wedges (2) shall be placed at all joints.

8.03 **REPAIRS**: Leakage or other failures in water main and joints installed under the Contract shall be repaired as follows:

A. Mechanical Joint:

1. Check bolts with torque wrench.

2. Remove gland and clean out joint and gasket: reassemble.

3. Cut out section of pipe; replace gasket and gland and reassemble, using a solid mechanical joint sleeve.

B. Roll-on Rubber Gasket - Cut out section of pipe, replace gasket and gland and reassemble, using a solid mechanical joint sleeve

C. For HDPE repairs, refer to Plastics Pipe Institute MAB-04 publication and the "Handbook of Polyethylene Pipe" current edition.

9.00 SETTING VALVES AND FIRE HYDRANTS

9.01 **GENERAL**: Valves, fittings, fire hydrants, plugs and caps shall be set and jointed to the pipe in a manner heretofore specified for cleaning, laying and joining the pipe.

9.02 **VALVE BOXES AND MANHOLES**: A valve box or manhole shall be provided for every valve. The valve box shall not transmit shock or stress to the valve when the box cover is flush with the surface of the pavement or such other level as may be directed. The base section of the valve box shall be set two (2) inches above the flanged bonnet joint of the valve and accurately centered on the valve operating nut.

A manhole shall be provided for valves as specified in the project specifications or shown on the plans. The valve nut shall be readily accessible for operation through the manhole cover which shall be set flush with the finished grade or such other level as may be specified.

Manhole covers shall be E.J. 1040 with "WATER SUPPLY" cover and Royal Oak logo (EJ Part # 001040185).

9.03 **HYDRANT LOCATION**: Hydrants shall be located as shown or as directed by the Engineer in a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized. See details on pages WD-3 and WD-4. Location of hydrants on any improved lot may be varied if the lot owner requests such change in writing to the Engineer.

9.04 **HYDRANT POSITION**: All hydrants shall stand plumb and have hose nozzles facing the back of the curb of the roadway at 45^{o}.

Hydrants shall be set to the established grade, with the nozzles at least 12 inches above grade or as directed by the Engineer. Hydrants set with elbows or hydrant tees shall be rotated 90^{o} to conform to the above.

9.05 HYDRANT ASSEMBLY: Each hydrant must be connected to the main with a 6-inch ductile iron branch, regardless of the material used for main construction, and controlled by a 6-inch independent gate valve. The cost of the branch connection shall be included in the hydrant setting cost. Auxiliary valves and fittings are included in the Hydrant Assembly item.

10.00 TAPPING WATER MAIN:

As follows:

List of Maximum Tap Sizes

Pipe Diameter:	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
Cast Iron Direct	3/4"	1"	1 1/4"	1 1/2"	2"	2"	2 1/2"	2 1/2"	3"	4"
Asbestos -Cement Direct	3/4"	3/4"	1"	1"	1"	1"	1"	1"	1"	1"
Asbestos -Cement W/Double Strap Saddle	1"	1 1/2"	2"	2"	2"	2"	2"	2"	2"	2"

Threads on taps shall be Mueller type or owner's standard. Corporation cocks shall be set at recommended depth in pipe wall without over-stressing pipe wall or the corporation cock. All services shall be tapped at an angle of 45^{o} and a minimum cover of 5 feet maintained over the service.

11.00 REACTION BACKING

11.01 GENERAL: Reaction backing shall be concrete having a compressive strength not less than 2,000 p.s.i. at 28 days. Backing shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown in the tables below. The backing shall be placed such that the pipe and fitting joints will be accessible for repair. Refer to the following table:

Reaction Backing
Minimum Bearing Area against undisturbed trench wall, in square feet, for sand.

Pipe Size	Tees Plugs	90° Bend	45° Bend	22 ½° Bend	11 1/4° Bend
4"	1	2	1	1	1
6"	3	3	2	1	1
8"	4	6	3	2	1
10"	7	9	5	3	2
12"	9	11	6	3	2
14"	11	15	8	5	3
16"	13	20	10	6	3
18"	16	25	12	7	4
20"	20	28	14	8	4
24"	28	40	20	11	6

Other Soil Conditions:

Cemented sand or hardpan ..... Multiply above by 0.5
Gravel..... Multiply above by 0.7
Hard dry clay ..... Multiply above by 0.7
Soft Clay..... Multiply above by 2.0

Muck - secure all fittings with tie rod clamps or retainer glands, with concrete reaction backing the same as listed for sand conditions.

Example: 12" tee in a gravel soil

A 12" tee required 9 sq. ft. of reaction backing for sand;
or 9 S.F. x 0.7 = 6.3 S.F. for gravel

Bearing area against undisturbed trench wall must be 2' x 3.2' or 1.5 x 4.2'

11.02 PLUGS, TEES AND BENDS: All plugs, caps, tees and bends deflecting 11 ¼ inches or more shall be provided with reaction backing or suitable metal harness to prevent movement.

11.03 HYDRANTS: The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing poured in place.

12.00 TESTING, FLUSHING AND CHLORINATING WATER MAINS

12.01 GENERAL: Testing, flushing and chlorinating shall be under the direct supervision of the Engineer.

12.02 WATER USE REQUIREMENTS: The Contractor may use City water for flushing and pressure tests, when the following requirements have been met:

A. The water shall flow through a sanitary hose / pipe or tubing and a Michigan Department of Environment, Great Lakes, and Energy (EGLE) approved backflow

prevention device RPZ shall be used to prevent contamination of the existing water supply.

B. The backflow preventer device shall be on the list, approved by EGLE. The list is available within the latest version of the Cross Connection Rules Manual.:

https://www.michigan.gov/documents/deq/CrossConnectionManual_251521_7.pdf

C. Access to City water shall be done by way of existing, Engineer approved, hydrant or a corporation stop valve on an existing water main.

12.03 PRESSURE TESTS: After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure test (included as part of the Contract) of at least 1.5 times the working pressure at the point of testing. For HDPE, refer to the Plastics Pipe Institute TN-46 guidelines.

A. Test Pressure Restrictions - Test pressures shall:

1. Be 150 p.s.i.
2. Not exceed pipe or thrust-restraint design pressures.
3. Be of at least 2-hour duration
4. Not vary by more than 5 p.s.i.
5. Not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants. NOTE: Valves shall not be operated in either direction at differential pressure exceeding the rated pressure.
6. Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
7. Test trees shall be clean, free of leaks, have a calibrated meter capable of reading tenths of a gallon, and a calibrated pressure gauge that reads steady and accurate.

B. Pressurization - Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the City. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure.

C. Air Removal - Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the City.

D. Examination - Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the City.

12.04 **LEAKAGE TEST**: A leakage test (incidental to the Contract) shall be conducted concurrently with the pressure test.

A. Leakage Defined - Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 p.s.i of 150 p.s.i. after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

B. Allowable Leakage - No pipe installation will be accepted, if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

In which: L = the allowable leakage, in gallons per hour
S = the length of pipe tested, in feet
D = the nominal diameter of the pipe, in inches
P = the average test pressure during the leakage test, in pounds per square inch gauge.

Allowable Leakage per 1000 feet of Pipeline*

(gallons per hour)

Avg. Test Pressure	Nominal Pipe Diameter - Inches															
Psi	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.4	0.6	0.9	1.2	1.5	1.9	2.2	2.5	2.8	3.1	3.8	4.7	5.7	6.6	7.6	8.6
400	0.4	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.5	5.4	6.3	7.2	8.1
350	0.4	0.5	0.8	1.1	1.4	1.6	1.9	2.2	2.5	2.8	3.3	4.2	5.0	5.9	6.7	7.5
300	0.3	0.5	0.7	1.0	1.3	1.5	1.8	2.0	2.3	2.6	3.1	3.9	4.6	5.4	6.2	7.0
275	0.3	0.5	0.7	1.0	1.2	1.4	1.7	1.9	2.2	2.4	2.9	3.7	4.4	5.2	5.9	6.7
250	0.3	0.4	0.7	0.9	1.1	1.4	1.6	1.9	2.1	2.3	2.8	3.5	4.2	499	5.7	6.4
225	0.3	0.4	0.6	0.9	1.1	1.3	1.5	1.8	2.0	2.2	2.7	3.3	4.0	4.7	5.4	6.0
200	0.3	0.4	0.6	0.8	1.0	1.2	1.4	1.7	1.9	2.1	2.5	3.1	3.8	4.4	5.0	5.7
175	0.3	0.4	0.5	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.3	2.9	3.5	4.1	4.7	5.3
150	0.2	0.3	0.5	0.7	0.9	1.1	1.2	1.4	1.6	1.8	2.2	2.7	3.3	3.8	4.4	4.9
125	0.2	0.3	0.5	0.6	0.8	1.0	1.1	1.3	1.5	1.6	2.0	2.5	3.0	3.5	4.0	4.5
100	0.2	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1,5	1.8	2.2	2.7	3.1	3.6	4.0

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

12.05 **ELECTRICAL CONTINUITY**: Ductile iron mains may be tested for electrical continuity at the City's expense. The Contractor shall locate and repair any breaks found in the electrical circuit.

12.06 **FLUSHING WATER MAIN**: The water main shall be flushed by providing taps in sufficient size or number to provide a flow rate of 3 feet per second in the line being flushed. Hydrants may be used providing the requirements listed below are met:

A. Procedure - The Contractor shall submit to the Engineer a procedure schedule outlining the method he proposed to use for flushing water mains. Mains shall be flushed at a maximum of 1/4 mile intervals.

B. Time for Flushing - Flushing may be done prior to pressure testing or following pressure testing, but in any case, prior to chlorination of the water main.

C. Flushing points shall extend the water outlet via hose to the street gutter line or near an existing catch basin. Hose ends shall be secured and protected by barricade.

12.07 **CHLORINATION**: All newly laid lines shall be chlorinated and shall be done in accordance with AWWA C651 “Disinfecting Water Mains”. The Contractor shall furnish all necessary equipment and materials and shall furnish all necessary assistance for effective disinfection of the water mains.

A. Procedure - After the water main has been pressure tested and flushed the Contractor shall pump a chlorine solution into the water main in such a manner and at such strength that the residual free chlorine shall be 50 to 100 ppm.

1. High Test Calcium Hypochlorite - ("HTH", "Perchloren", Pittchlor"). Prepare a 10,000 parts per million solution water (1) and pump at a constant rate into the water main while bleeding off the water at the extreme end. The bleed rate will determine the feed rate of the chlorine in order to arrive at a 50 to 100 ppm solution in the water main.

2. Liquid Chlorine - Liquid chlorine may be applied to the water main much in the same way as the hypochlorite solution listed above. The rate of application will have to be adjusted for the degree of concentration of the liquid chlorine.

B. Point of Application - The chlorinating agent shall be applied at the supply end of the line through a corporation cock. The water for injecting the chlorine into the new main may be taken from the pressure side of the isolation valve or by utilizing a pressure pump. Care shall be exercised to prevent any of the strong chlorine solution from entering the existing water main.

C. Retention Period - The chlorinated water shall be retained in the new water main for a period not to exceed 24 hours nor less than 16 hours in the event 50 parts per million is used, or not to exceed 12 hours nor less than 8 hours if a 100 parts per million solution is used. In cases where a shorter retention period is necessary, a stronger solution may be used and the retention period reduced accordingly. For these stronger solutions, the approval of the Engineer must be secured in writing as to the length of retention time in relationship to chlorine strength.

While the chlorine solution is in the line, the Contractor shall operate valves in the chlorinated section to insure the complete disinfection thereof.

D. Flushing and Testing - Chlorinated water shall be flushed from the main at the end of the retention time so that the entire line is clear of any residual chlorine.

After the line is flushed, two (2) consecutive day samples shall be taken from the line by the **Southeastern Oakland County Water Authority** (SOCWA @ 248-288-5150)

for bacteriological analysis. These test samples are taken Monday through Thursday and must be scheduled by the Contractor with SOCWA.

In the event the water does not pass this bacteriological test, the test procedure outlined above shall be repeated until the quality of water is substantially the same as that being delivered from existing distribution system.

12.08 PRESSURE TESTS AND CHLORINATING REPORT FORMS: Before placing the new pipelines into service, a successful pressure test and a report submitted by SOCWA verifying negative bacteria tests on samples collected. Water sample reports shall be emailed or mailed to the Engineer.

13.00 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

13.01 WATER MAIN: Water main shall be measured in place by linear feet along the centerline of the pipe. No deductions will be made in this measurement for the laying length of fittings.

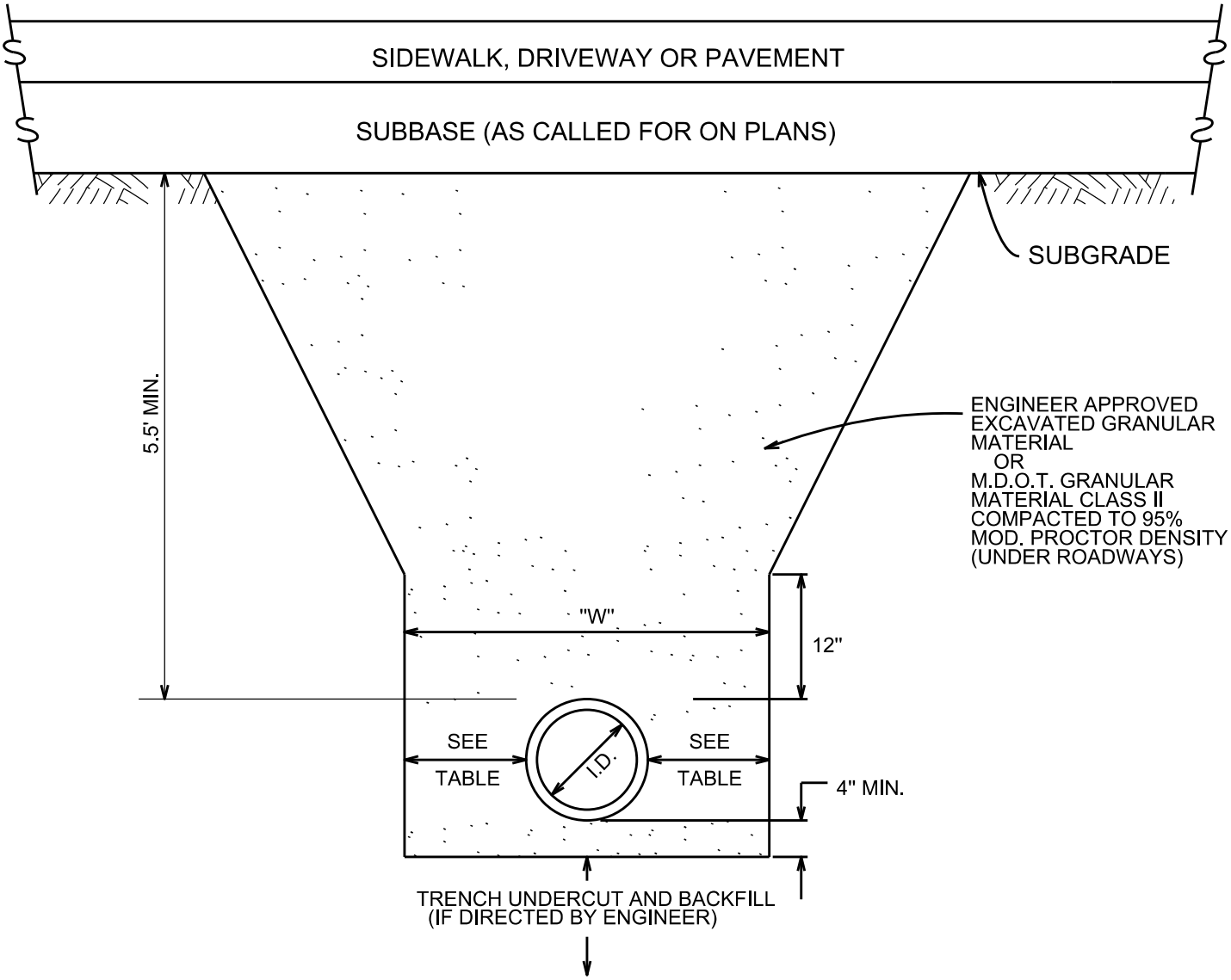
13.02 HYDRANTS AND VALVES: Hydrants and valves will be counted and paid for under the appropriate item in the Proposal.

13.03 REACTION BACKING: Reaction backing, tie rods, clamps and retainer glands will be considered included in the water main construction. Their cost shall be included under the appropriate fitting item in the Proposal.

13.04 ANCHORAGE AND ENCASEMENT: The contractor shall furnish and place all concrete encasements as called out in the drawings. Their cost shall be included under the appropriate item in the Proposal

13.05 FITTINGS: Fittings will be paid as water main by linear feet in place along the centerline of the fitting, unless paid as extra fitting in the Proposal.

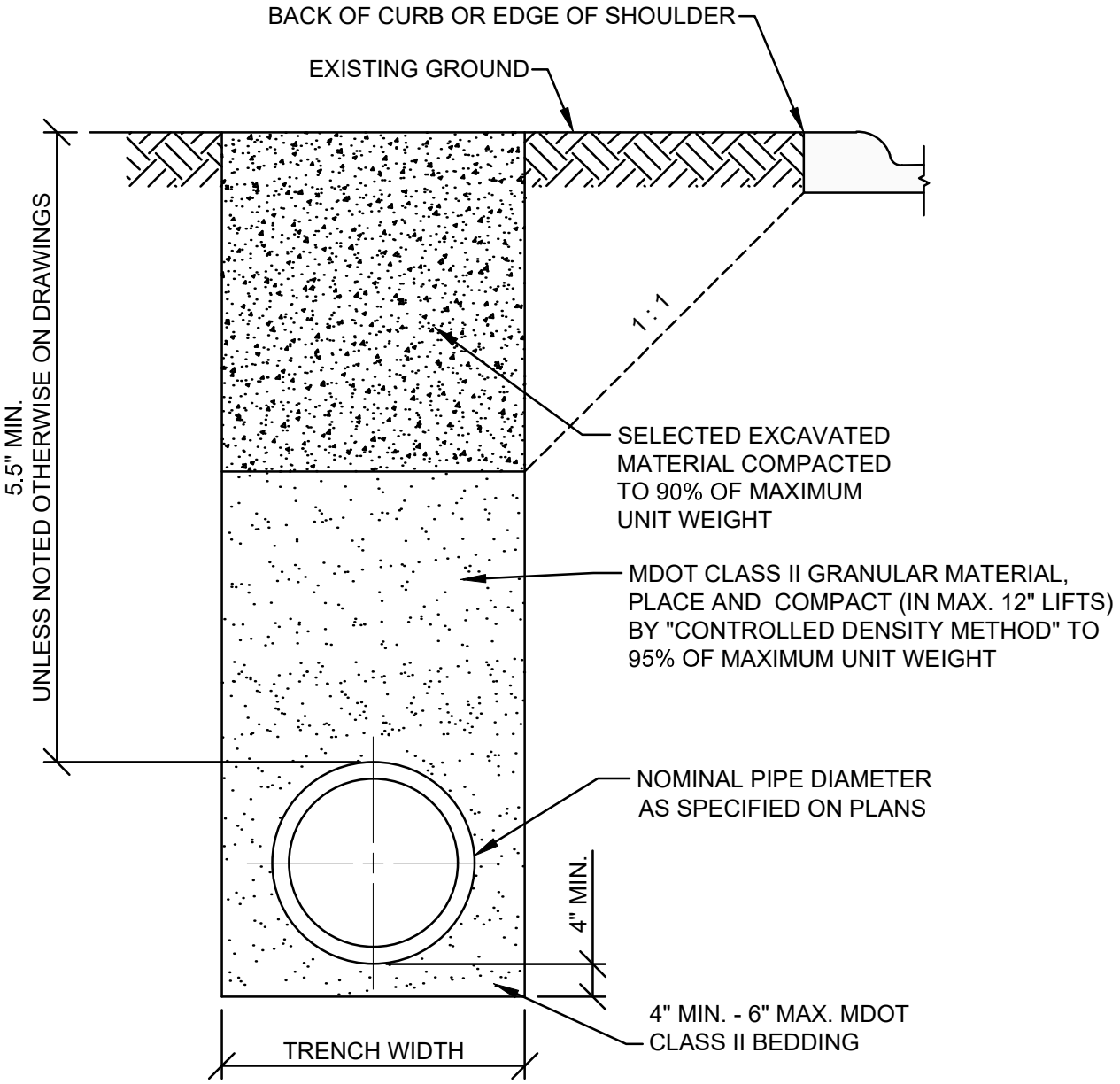
WATER MAIN DETAILS



THE FOLLOWING ARE MAXIMUM TRENCH WIDTHS:

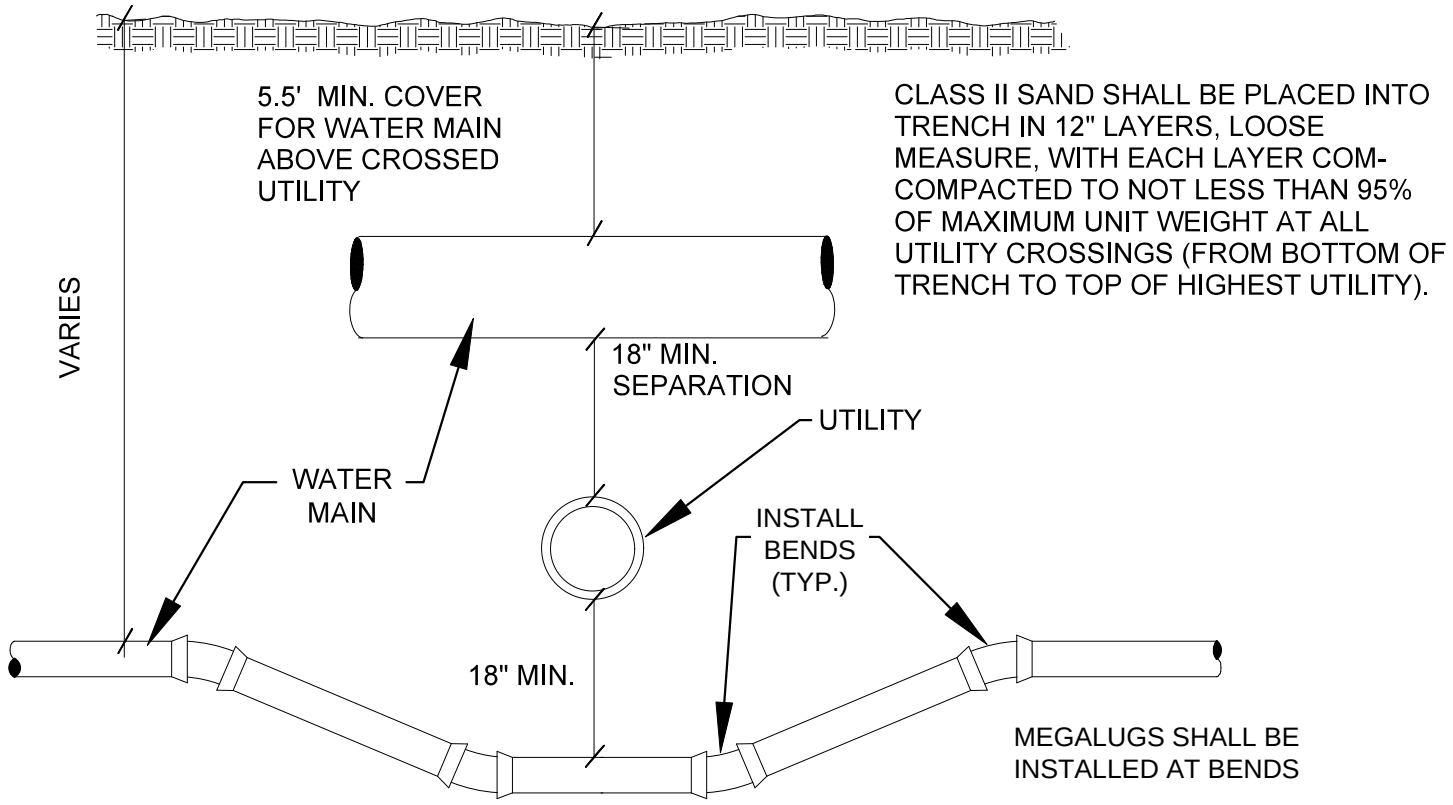
NOMINAL PIPE DIAMETER	<18"	18" TO 24"	>24"
"W" TRENCH WIDTH (FT.)	30"	PIPE DIAMETER + 18"	PIPE DIAMETER + 24"

WATER MAIN TRENCH



NOMINAL PIPE DIAMETER	MAXIMUM TRENCH WIDTH
LESS THAN 18"	30"
18" TO 24"	PIPE DIAMETER PLUS 18"
GREATER THAN 24"	PIPE DIAMETER PLUS 24"

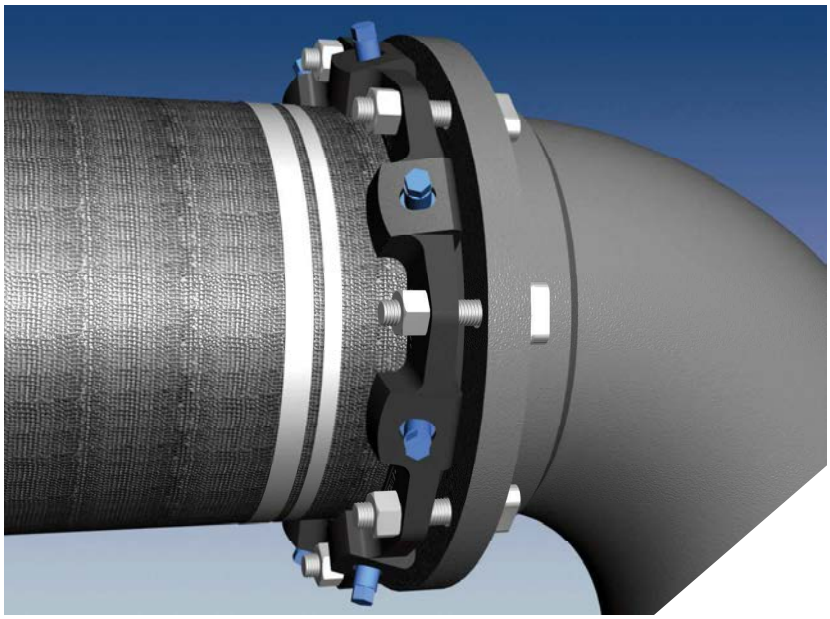
STANDARD TRENCH FOR WATER MAIN WITHIN INFLUENCE OF ROAD BED



UTILITY CROSSING

MEGALUG®
Series 1100

Mechanical Joint Restraint for Ductile Iron Pipe



Nominal Pipe Size	Series Number	Shipping Weights	Post Assembly Deflection	Pressure Rating (PSI)
3	1103	6.1	3°	350
4	1104	7.7	3°	350
6	1106	11.9	3°	350
8	1108	14.8	3°	350
10	1110	23.9	3°	350
12	1112	31.2	3°	350
14	1114	48.5	2°	350
16	1116	56.4	2°	350
18	1118	63.1	1½°	250
20	1120	72.3	1½°	250
24	1124	133.1	1½°	250
30	1130	194.6	1°	250
36	1136	234.0	1°	250
42	1142	536.0	1°	250
48	1148	653.0	1°	250
54	1154	700.2	0.5°	250

NOTE: For applications or pressures other than those shown please contact EBAA for assistance.

Features and Applications:

- Sizes 3 inch through 54 inch
- Constructed of ASTM A536 Ductile Iron
- Torque Limiting Twist-Off Nuts
- MEGA-BOND®
  Restraint Coating System
  For more information on MEGA-BOND, refer to www.ebaa.com
- The Mechanical Joint Follower Gland is incorporated into the restraint
- Heavy Duty thick wall design
- Support Products Available:
  Split repair style available 3 inch through 48 inch.
  EBAA Series 1100SD

  Solid restraint harness available for push-on pipe bells.
  EBAA Series 1700

  Split restraint harness available for existing push-on bells.
  EBAA Series 1100HD
- All MEGALUG and related restraint products can be furnished as packaged accessories complete with appropriate restraint, gasket, lubrication, and bolting hardware
- For use on water or wastewater pipelines subject to hydrostatic pressure and tested in accordance with either AWWA C600 or ASTM D2774

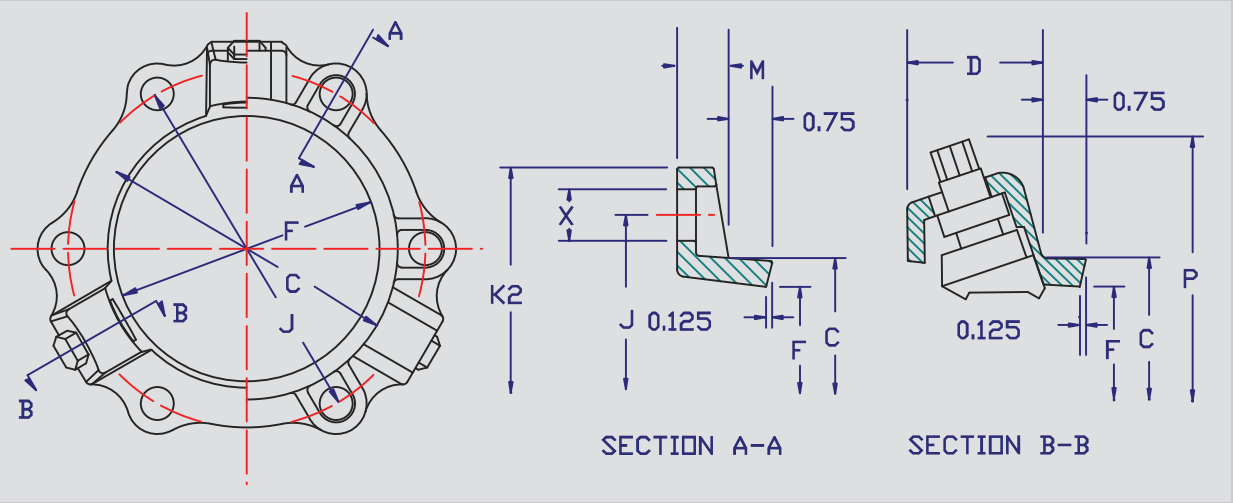
Made In The USA

U.S. Patent Nos.
4092036, 4627774, 4779900, 4896903, 5544922

0222-K

Series 1100 Submittal Reference Drawing

EBAA IRON



MADE IN USA

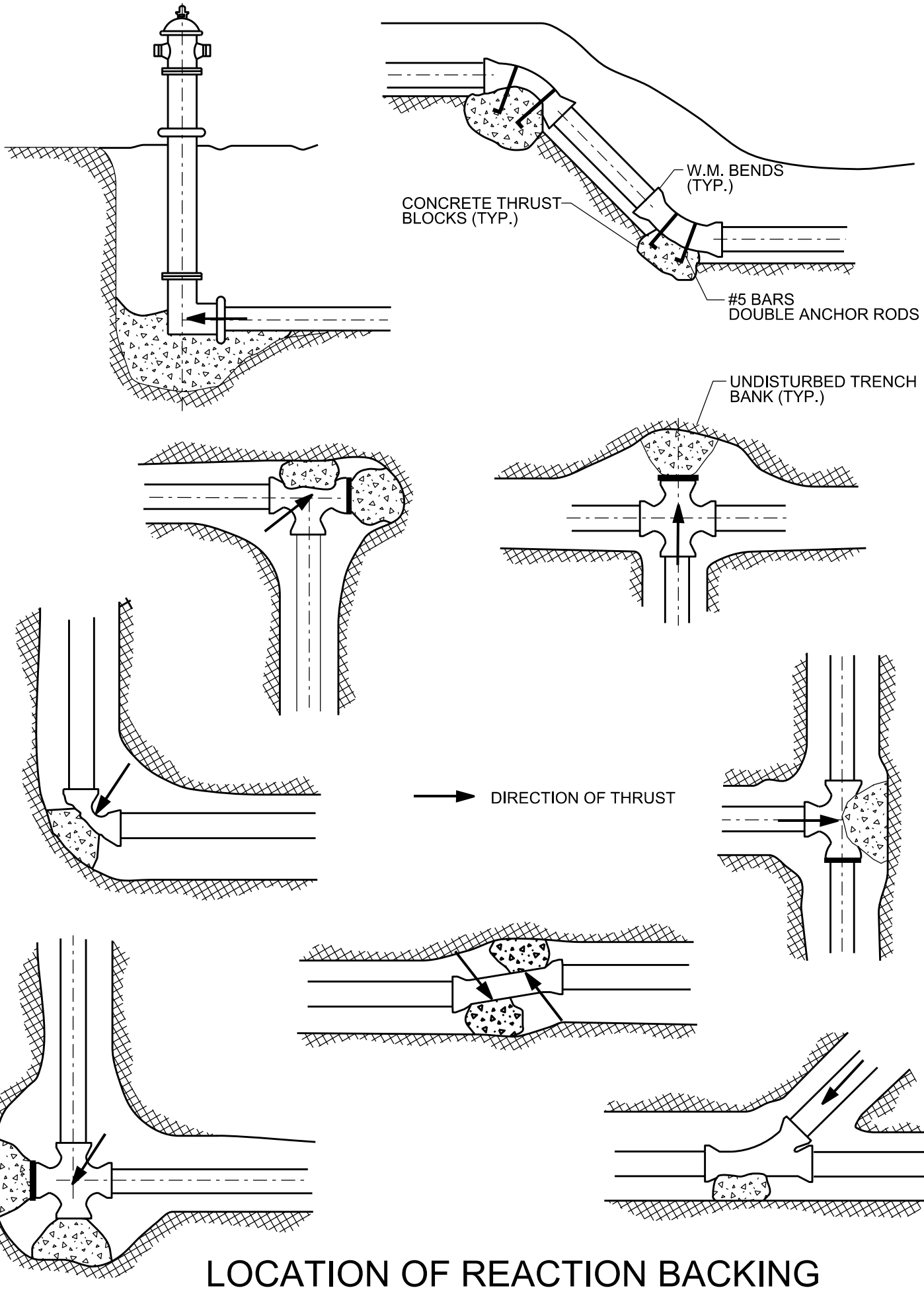
Nominal Pipe Size	Series Number	C	D	F	M	P*	X	J	K2	Wedge QTY.	Bolt (QTY.-Size)	Weight (LBS.)	Pressure Rating (PSI)
3	1103	4.48	2.27	4.06	0.62	9.06	0.750	6.19	7.69	2	4 - ⅝ x 3	6.1	350
4	1104	5.92	2.27	4.90	0.75	9.90	0.875	7.50	9.12	2	4 - ¾ x 3½	7.7	350
6	1106	8.02	2.27	7.00	0.88	12.00	0.875	9.50	11.12	3	6 - ¾ x 3½	11.9	350
8	1108	10.17	2.31	9.15	1.00	14.15	0.875	11.75	13.37	4	6 - ¾ x 4	14.8	350
10	1110	12.22	2.37	11.20	1.00	16.20	0.875	14.00	15.62	6	8 - ¾ x 4	23.9	350
12	1112	14.32	2.37	13.30	1.25	18.30	0.875	16.25	17.88	8	8 - ¾ x 4	31.2	350
14	1114	16.40	2.69	15.44	1.50	20.94	0.875	18.75	20.25	10	10 -¾ x 4½	48.5	350
16	1116	18.50	2.69	17.54	1.56	22.90	0.875	21.00	22.50	12	12 -¾ x 4½	56.4	350
18	1118	20.60	2.69	19.64	1.63	25.00	0.875	23.25	24.75	12	12 -¾ x 4½	63.1	250
20	1120	22.70	2.69	21.74	1.69	27.10	0.875	25.50	27.00	14	14 -¾ x 4½	72.3	250
24	1124	26.90	3.20	25.94	1.81	32.64	0.875	30.00	31.50	16	16 -¾ x 5	133.1	250
30	1130	33.29	3.20	32.17	2.25	38.87	1.125	36.88	39.12	20	20 - 1 x 6	194.6	250
36	1136	39.59	3.20	38.47	2.25	45.17	1.125	43.75	46.00	24	24 - 1 x 6	234.0	250
42	1142	45.79	4.56	44.67	3.88	55.57	1.375	50.62	53.48	28	28 - 1¼ x 8½	536.0	250
48	1148	52.09	4.56	50.97	3.88	61.87	1.375	57.50	60.36	32	32 - 1¼ x 8½	653.0	250
54	1154	58.82	4.56	57.73	3.88	66.40	1.375	63.20	66.33	36	36 - 1¼ x 9½	700.3	250

* With Twist-Off Nuts twisted off.

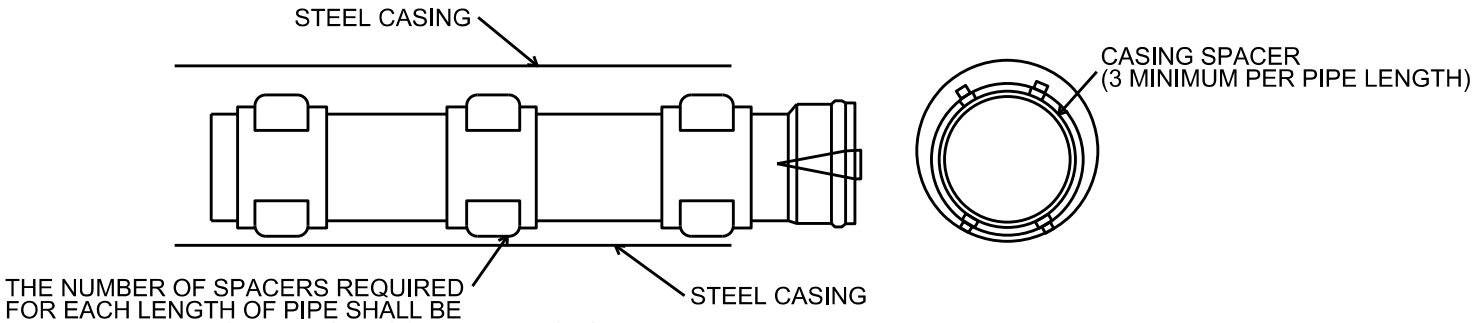
NOTE: Dimensions are in inches (±1%) and are subject to change without notice.

Important Notes

- The Series 1100 MEGALUG should not be used on plain end fittings.
- If encased in concrete, polyethylene wrap must be used to prevent concrete intrusion into the wedge pocket.
- For test pressures above the rated pressures shown, contact EBAA for recommendations, such as tandem restraint for high pressure applications.
- If you experience the need to install the Series 1100 MEGALUG in an unconventional manner please consult our engineering department.
- EBAA-Seal™ Mechanical Joint Gaskets are provided with 30 inch through 54 inch MEGALUG restraints. These are required on the above referenced sizes to accommodate the pressure ratings and safety factors shown.
- Extra length T-bolts are provided with the 42 inch, 48 inch and 54 inch sizes to facilitate easier assembly of the mechanical joint.
- All Series 1100 MEGALUG components are made of ductile iron conforming to ASTM A536. The wedges are heat treated to a hardness range of 370 to 470 BHN.
- LISTINGS AND APPROVALS: Sizes 3 inch through 24 inch are listed by Underwriters Laboratories, Inc. Category HJKF "Fittings, Retainer Type" with a deflection angle of 5 degrees (3 inch through 12 inch) and 2½ degrees (14 inch through 24 inch). The listing file number is EX2836, Sizes 3 inch through 12 inch are Factory Mutual approved.
- The Series 1100 MEGALUG is intended for use on ductile iron pipe. The restraint can be used on grey iron pipe if the pipe is not severely corroded and is in sound condition and has an outside diameter that can be accommodated. For more information on the use of the MEGALUG restraint on grey iron pipe ask for Connections Bulletin DI-1.



LOCATION OF REACTION BACKING



NOTES:

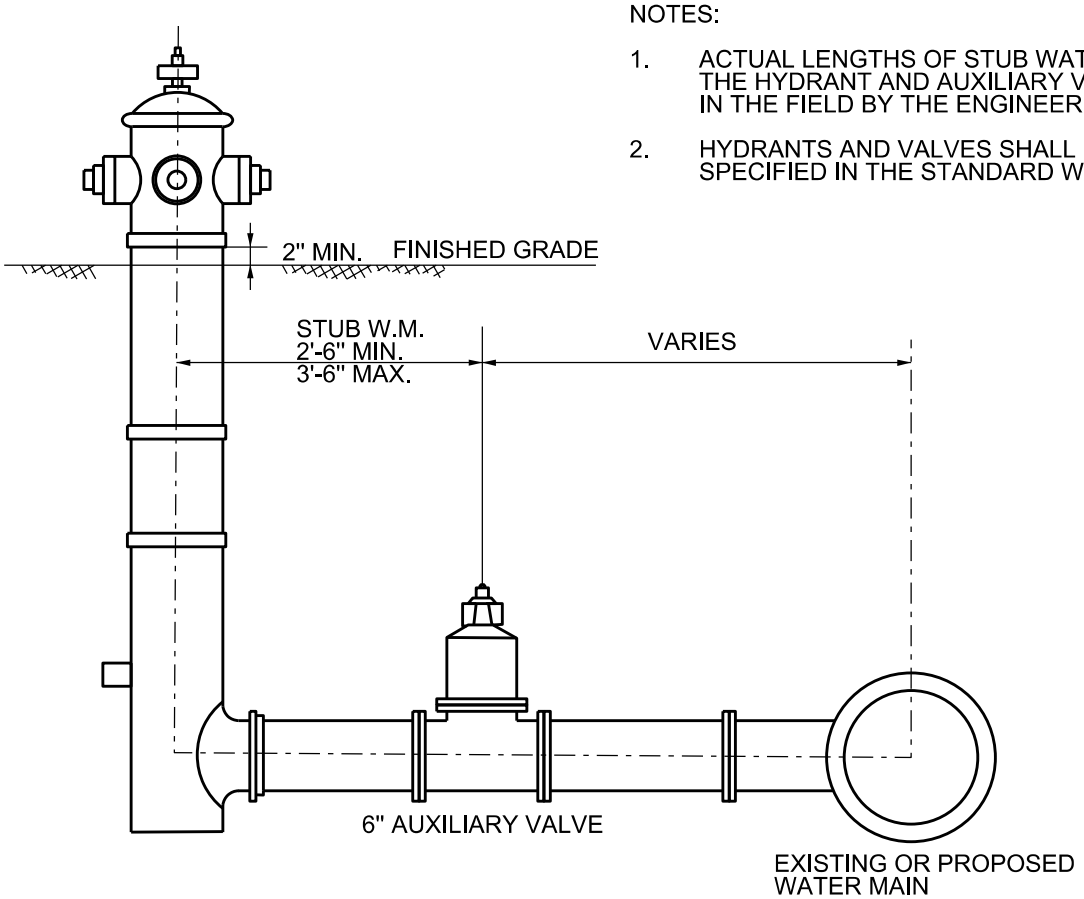
1. CASING SPACERS SHALL BE ADVANCED PRODUCT SYSTEMS (APS) MODEL OR APPROVED EQUAL.
2. FIELD LOCK GASKETS (OR APPROVED EQUAL) ARE REQUIRED ON ALL JOINTS INSIDE CASING & FIRST JOINT OUTSIDE CASING.
3. THE ENDS OF THE CASING SHALL BE SEALED AFTER WATER MAIN IS INSTALLED THROUGH THE CASING.

PIPE SIZE	RECOMMENDED MIN. CASING DIAMETER (O.D.)	MINIMUM CASING WALL THICKNESS
4"	12.75"	0.375"
6"	14"	0.375"
8"	16"	0.375"
12"	20"	0.375"
16"	24"	0.406"
24"	36"	0.532"

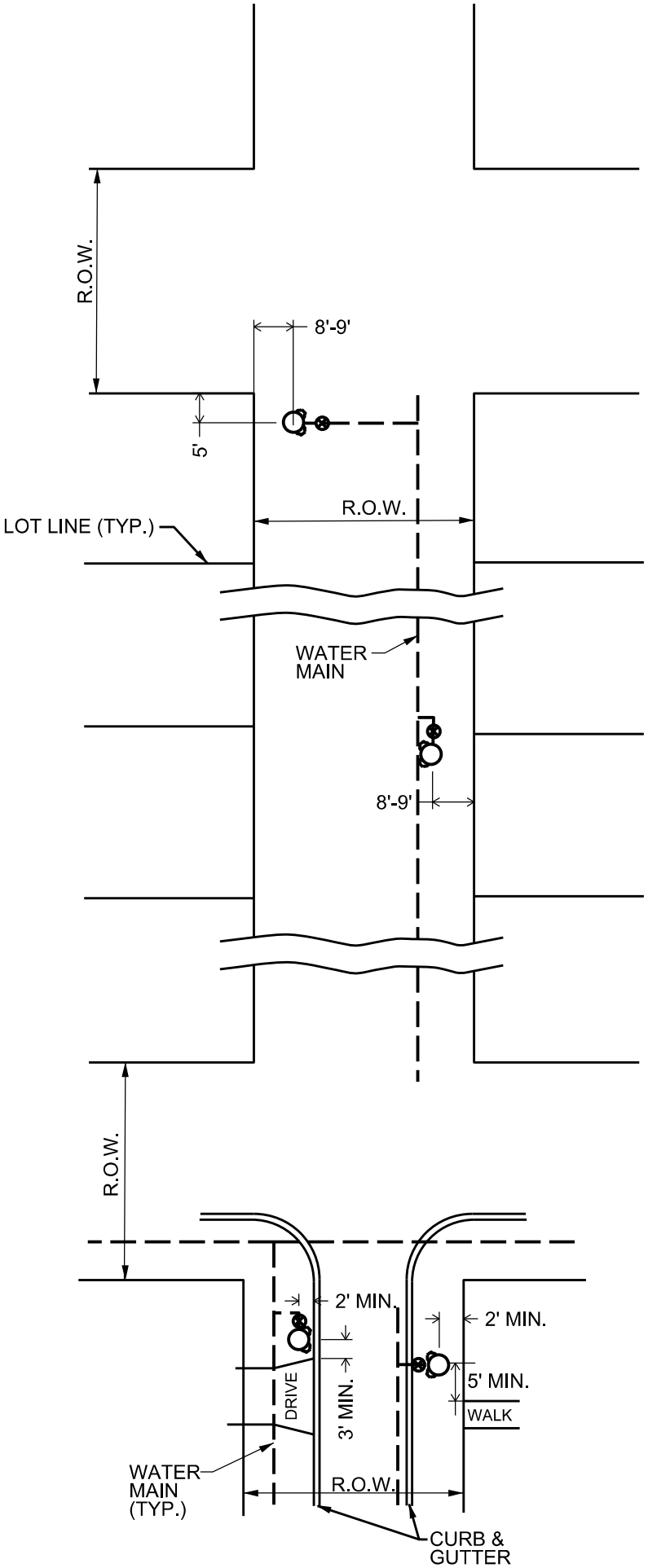
STEEL CASING REQUIREMENTS

NOTES:

1. ACTUAL LENGTHS OF STUB WATER MAIN BETWEEN THE HYDRANT AND AUXILIARY VALVE WILL BE SET IN THE FIELD BY THE ENGINEER.
2. HYDRANTS AND VALVES SHALL BE OF THE TYPE SPECIFIED IN THE STANDARD WATER MAIN DETAILS.

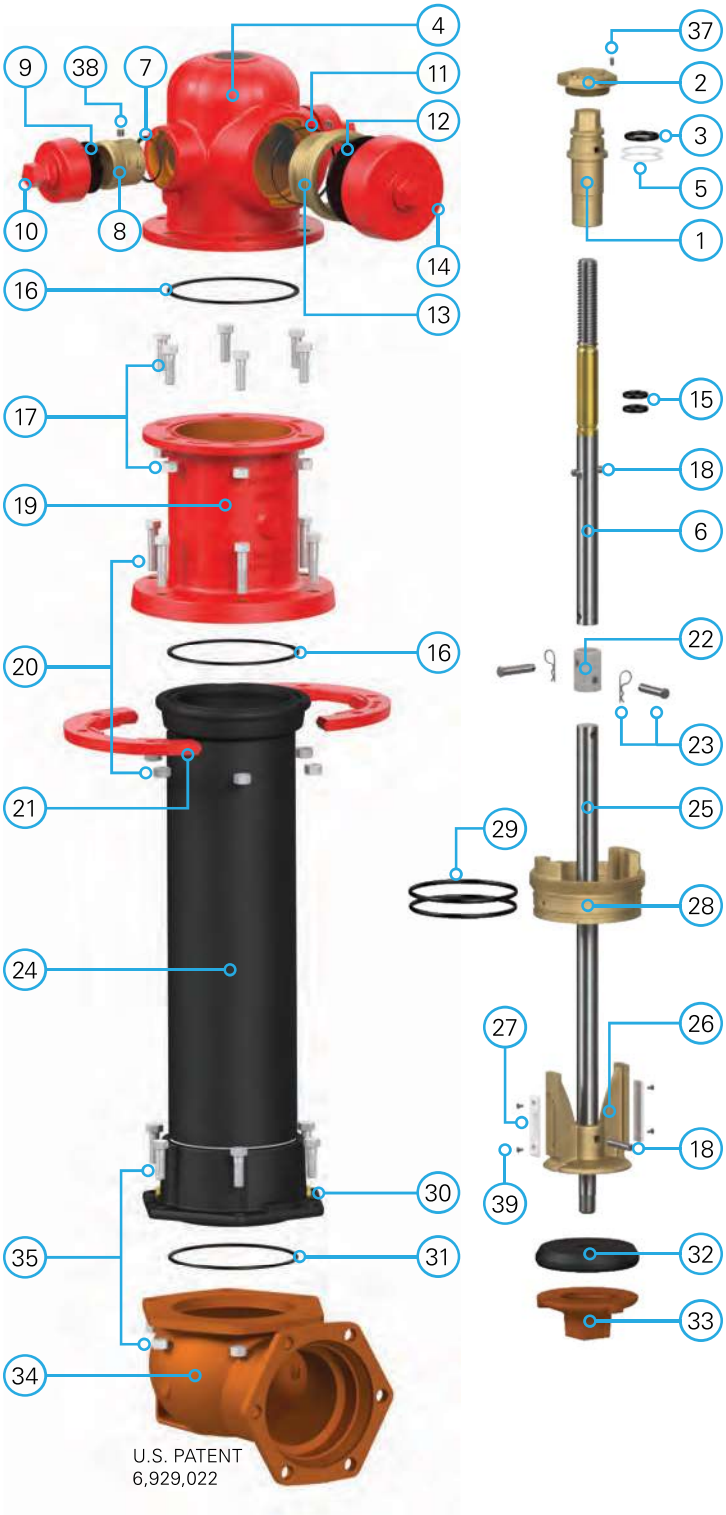


AUXILIARY VALVE LOCATION



TYPICAL HYDRANT AND VALVE LOCATIONS

WaterMaster® 5BR250 Hydrant Parts
250 psi Rated



WaterMaster 5BR250 Hydrant Parts ~~(3-Way Nozzle)~~ Provide 2-Way Nozzle

No.	Part Description	Qty	Part Material
1	Operating Nut	1	Bronze
2	Hold Down Nut	1	Bronze
3	Weather Seal O-Ring	1	Rubber, Buna-N
4	Bonnet	1	Ductile Iron
5	Thrust Washers	2	Delrin
6	Operating Stem Top 21 1/2"	1	Steel with Brass Collar
7	Hose Nozzle O-Rings	2	Rubber, Buna-N
8	Hose Nozzles	2	Bronze
9	Hose Nozzle Gaskets	2	Rubber
10	Hose Nozzle Caps	2	Cast Iron
11	Pumper Nozzle O-Ring	1	Rubber, Buna-N
12	Pumper Nozzle Gasket	1	Rubber
13	Pumper Nozzle	1	Bronze
14	Pumper Nozzle Cap	1	Cast Iron
15	Reservoir O-Rings	2	Rubber, Buna-N
16	Quad-Ring®	2	Rubber, Buna-N
17	Bonnet Bolts & Nuts	6	Zinc Plated Steel
18	Drive-Loc Pins	2	Stainless Steel
19	Traffic Standpipe Upper	1	Ductile Iron
20	Safety Flange Bolts & Nuts	6	Zinc Plated Steel
21	Swivel Flanges (Frangible)	1	Cast Iron
22	Stem Coupling (Frangible)	1	Galvanized Steel
23	Coupling Pin & Cotter Keys	2	Stainless Steel
24	Standpipe Lower Section	1	Ductile Iron with Bronze Liner
25	Operating Stem Lower	1	Steel
26	Drip Shutoff, HP	1	Bronze
27	Inserts, HP	2	HDPE
28	Valve Seat	1	Bronze
29	Valve Seat O-Rings	2	Rubber, Buna-N
30	Brass Drain Hole Bushings	2	Brass
31	Inlet Flange O-Ring	1	Rubber, Buna-N
32	Seating Valve Rubber	1	Rubber
33	Valve Washer	1	Ductile Iron/Epoxy
34	Bottom Inlet	1	Ductile Iron/Epoxy
35	Inlet Flange Bolts & Nuts	6	Stainless Steel
36	Chains*	3	Zinc Plated Steel
37	Set Screw 1/4 - 20 SS Cone Pt.	1	Stainless Steel
38	Pipe Plugs 1/4 NPTF SS HX	3	Stainless Steel
39	Insert Screws, HP	4	Stainless Steel

*Not Shown

Conforms to ANSI/AWWA Standard C502 Underwriters Laboratories Listed Factory Mutual Approved NSF/ANSI 61 & 372 Certified

WaterMaster® Fire Hydrant Specification

WaterMaster® Fire Hydrant Specifications for
City of Royal Oak

1. Manufacturers shall provide sufficient documentation to assure that their dry-barrel fire hydrant will successfully meet the latest revisions of AWWA Standard C502. Fire hydrants shall be rated for **250 psi working pressure and be listed by Underwriters Laboratories Inc. (UL 246) and meet the test requirements of Factory Mutual (FM 1510) at this pressure**.

2. Hydrants shall have a minimum 5 1/4" valve opening.

3. Hydrants shall be of a true compression type, opening against the pressure and closing with the pressure. Composition of the main valve shall be a molded rubber having a durometer hardness of 91 +/- 5. The rubber seat valve shall fit a 5 1/4" opening and not be less than 1" thick.

4. Fire hydrants shall be **two-way** in design, having **3 3/4" Detroit FD D Dome Only** and **5" Harrington Storz D Dome** pumper nozzles. Nozzles shall “thread” counterclockwise into hydrant barrel utilizing O-ring pressure seals. A suitable nozzle lock shall be in place to prevent inadvertent nozzle removal. Wedging devices and/or ductile iron retainer rings to secure nozzles shall not be allowed.

5. The lubrication system shall be sealed from the waterway and any external contaminants by use of O-ring pressure seals. Anti-friction washers shall be in place above and below the thrust collar of the operating nut to further minimize operating torque. The grease reservoir shall be factory filled with an FDA approved food grade lubricant. Oil shall not be used.

6. The operating nut shall be a one-piece design, manufactured of ASTM B-584 bronze. It shall be **1 1/8" Pentagon- point to flat** in size/shape. The operating nut shall be affixed to the bonnet by means of an ASTM B-584 bronze hold down nut. The hold down nut shall be threaded into the bonnet in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. A resilient weather seal shall be incorporated with the hold down nut, for the purpose of protecting the operating mechanism from the elements.

7. The direction of opening shall be **left**. An arrow shall be cast on the top of the hydrant to indicate the opening direction.

8. The hydrant bonnet shall be attached to the upper barrel by no more than six bolts and nuts. All nuts and bolts below grade shall be 304 stainless steel.

9. The hydrant will have **6'** depth of bury, unless otherwise noted.

10. Hydrants shall be of the "Traffic Model" design, provided with a safety coupling and flange design that will permit a full 360 degree facing of the nozzles. O-rings shall be the Quad-Ring® type and be installed in a groove on the bottom of the joint so that taping or gluing to the upper standpipe or extension is not required. The safety coupling shall be a one piece design. Multiple parts and cast iron not allowed.

11. The operating stem shall be a two-piece design, not less than 1 1/4" diameter (excluding threaded or machined areas). Threads shall be Acme type with no 60 degree V threads allowed. Travel stops shall be in the inlet/shoe and are not allowed in the bonnet area. Screws, pins, bolts or fasteners used in conjunction with the stem coupling shall be stainless steel.

12. The inside diameter of the hydrant barrels shall not be less than 7 1/4" and the hydrant shall be painted **Red**.

13. Heavy duty drip shutoff (top plate) and valve seat shall be high strength manganese bronze. Valve seat shall be installed in a bronze seat ring. Drain shall be **tapped and plugged,** bronze lined and 3/8 inch diameter minimum. They shall operate without the use of springs, toggles, tubes, levers or other intricate synchronizing mechanisms. Lower valve plate shall be a one piece ductile iron casting and not require a separate cap nut. Drains shall be open and flushed during the first four turns of opening the hydrant before positively closing while operating the hydrant.

14. The shoe connection shall be **Mechanical Joint** or as specified. The inlet/shoe shall be fusion bonded epoxy coated per ANSI/AWWA C550 and with an NSF 61 approved coating having ample blocking pads for sturdy setting. Six stainless steel bolts and nuts are required to fasten the shoe to the lower barrel. The shoe/inlet shall be directly connected to the standpipe flange. Designs using a sandwich piece in between the standpipe and shoe/inlet shall not be allowed.

15. The top bonnet, upper standpipe, lower standpipe and shoe shall be ductile iron to ensure strength throughout the exterior of the hydrant. Gray Iron hydrant body parts will not be allowed.

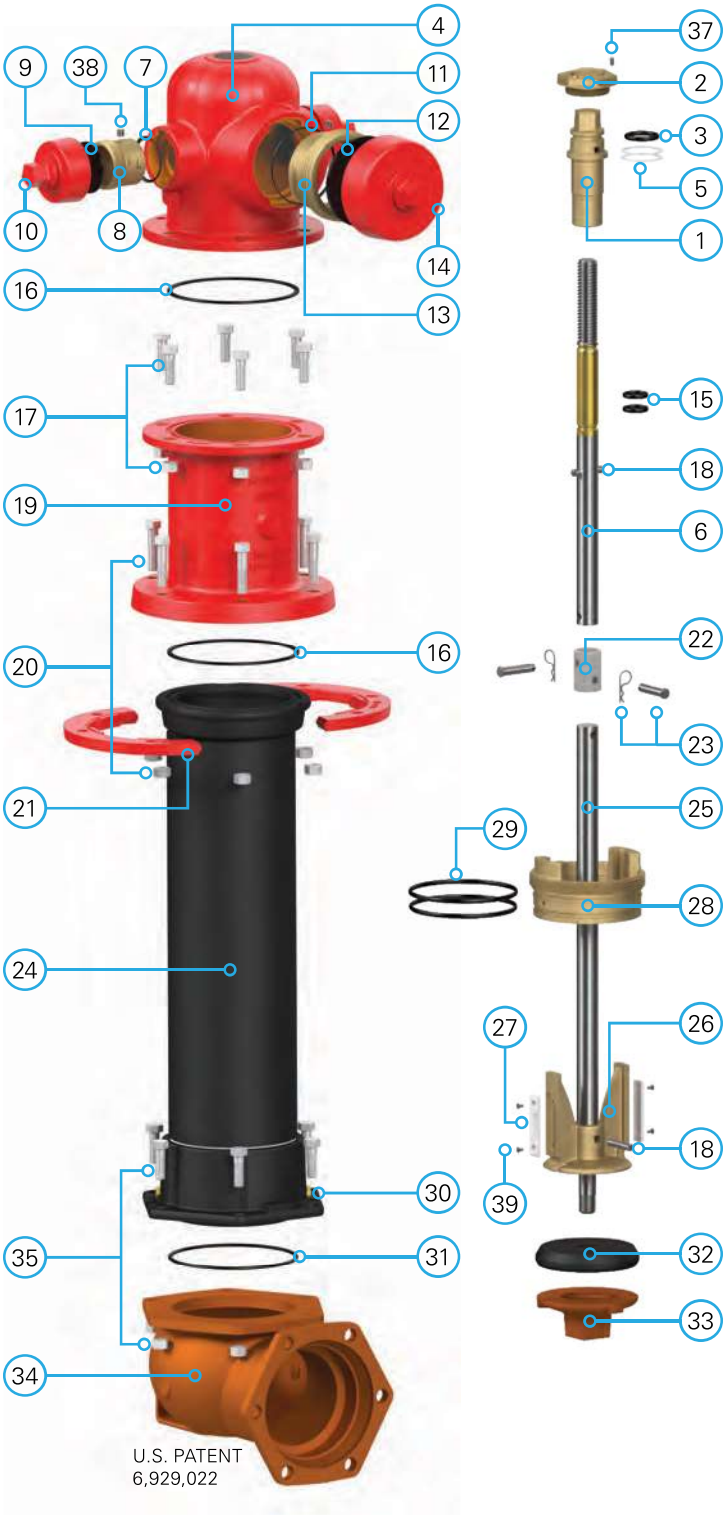
Municipality reserves the right to accept only those materials which are in full compliance with these specifications and deemed most advantageous to its interests.

Upon request, supplier shall furnish flow data indicating friction loss in psi at a flow of 1,000 gpm from the pumper nozzle. Such friction loss shall not exceed 2.5 psi. Also, the municipality may request the manufacturing "point of origin" for any/or all hydrant parts. All cast components shall be made in the USA.

Failure to comply with any of these above requirements is sufficient cause for rejection of proposed hydrants.

Hydrant shall be EJ WaterMaster® **5BR250**.
6’0” part # 55980D or 55030D,
5’6” part # 54957D or 54949D,
5’0” part # 53949D,
4’6” part # 52949D,

WaterMaster® 5BR250 Hydrant Parts
250 psi Rated



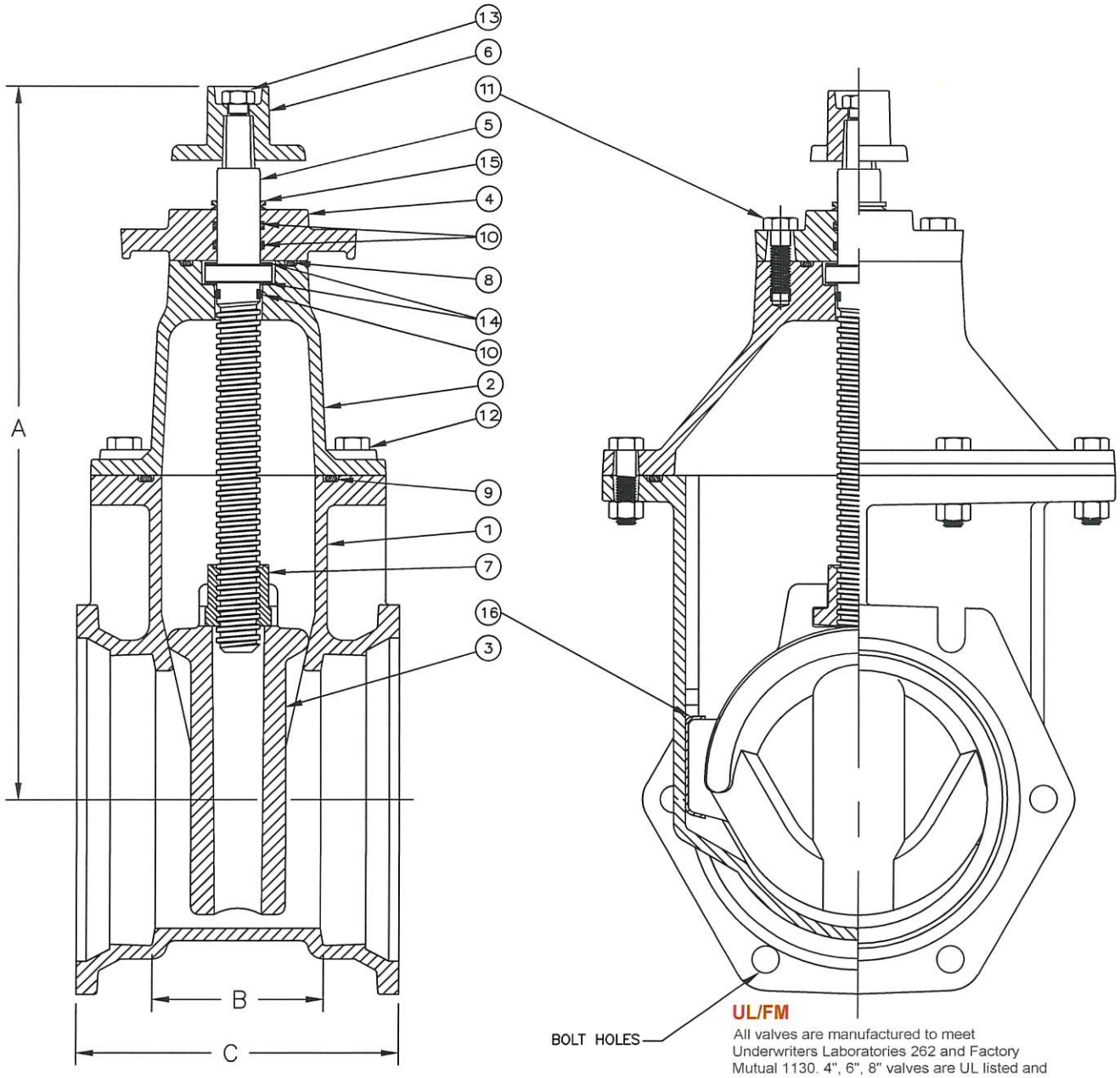
WaterMaster 5BR250 Hydrant Parts ~~(3-Way Nozzle)~~ Provide 2-Way Nozzle

No.	Part Description	Qty	Part Material
1	Operating Nut	1	Bronze
2	Hold Down Nut	1	Bronze
3	Weather Seal O-Ring	1	Rubber, Buna-N
4	Bonnet	1	Ductile Iron
5	Thrust Washers	2	Delrin
6	Operating Stem Top 21 1/2"	1	Steel with Brass Collar
7	Hose Nozzle O-Rings	2	Rubber, Buna-N
8	Hose Nozzles	2	Bronze
9	Hose Nozzle Gaskets	2	Rubber
10	Hose Nozzle Caps	2	Cast Iron
11	Pumper Nozzle O-Ring	1	Rubber, Buna-N
12	Pumper Nozzle Gasket	1	Rubber
13	Pumper Nozzle	1	Bronze
14	Pumper Nozzle Cap	1	Cast Iron
15	Reservoir O-Rings	2	Rubber, Buna-N
16	Quad-Ring®	2	Rubber, Buna-N
17	Bonnet Bolts & Nuts	6	Zinc Plated Steel
18	Drive-Loc Pins	2	Stainless Steel
19	Traffic Standpipe Upper	1	Ductile Iron
20	Safety Flange Bolts & Nuts	6	Zinc Plated Steel
21	Swivel Flanges (Frangible)	1	Cast Iron
22	Stem Coupling (Frangible)	1	Galvanized Steel
23	Coupling Pin & Cotter Keys	2	Stainless Steel
24	Standpipe Lower Section	1	Ductile Iron with Bronze Liner
25	Operating Stem Lower	1	Steel
26	Drip Shutoff, HP	1	Bronze
27	Inserts, HP	2	HDPE
28	Valve Seat	1	Bronze
29	Valve Seat O-Rings	2	Rubber, Buna-N
30	Brass Drain Hole Bushings	2	Brass
31	Inlet Flange O-Ring	1	Rubber, Buna-N
32	Seating Valve Rubber	1	Rubber
33	Valve Washer	1	Ductile Iron/Epoxy
34	Bottom Inlet	1	Ductile Iron/Epoxy
35	Inlet Flange Bolts & Nuts	6	Stainless Steel
36	Chains*	3	Zinc Plated Steel
37	Set Screw 1/4 - 20 SS Cone Pt.	1	Stainless Steel
38	Pipe Plugs 1/4 NPTF SS HX	3	Stainless Steel
39	Insert Screws, HP	4	Stainless Steel

*Not Shown

Conforms to ANSI/AWWA Standard C502 Underwriters Laboratories Listed Factory Mutual Approved NSF/ANSI 61 & 372 Certified

Resilient Wedge Gate Valve



UL/FM

All valves are manufactured to meet Underwriters Laboratories 262 and Factory Mutual 1130. 4", 6", 8" valves are UL listed and 4" - 12" are FM approved.

Product

Resilient Wedge Gate Valve, Mech Joint x Mech Joint

Design Features

1. MECHANICAL JOINT END CONNECTIONS IN ACCORDANCE WITH ANSI/AWWA C111/A21.11
2. EJ RW GATE VALVES CONFORM TO:
   AWWA C515
   AWWA C550 (COATING)
3. WORKING PRESSURE = 250 PSI
   TEST PRESSURE = 500 PSI
4. POST INDICATOR VALVES ARE AVAILABLE (4"-14").

Components

ITEM #	DESCRIPTION	MATERIAL
1	BODY	DUCTILE IRON
2	BONNET	DUCTILE IRON
3	WEDGE	D.I./EPDM
4	SEAL PLATE	DUCTILE IRON
5	STEM	MANGANESE BRONZE
6	OPERATING NUT	CAST IRON
7	STEM NUT	MANGANESE BRONZE
8	O-RING	RUBBER, BUNA-N
9	BODY O-RING	RUBBER, BUNA-N
10	O-RING	RUBBER, BUNA-N
11	HEX CAP SCREW	STAINLESS STEEL
12	HEX CAP SCREW W/NUT	STAINLESS STEEL
13	HEX CAP SCREW	STAINLESS STEEL
14	THRUST WASHER	POLYMER
15	SHAFT SEAL	RUBBER, BUNA-N
16	EAR CAP	POLYMER

Dimensions

VALVE	A	B	C
2"	10 5/8"	3 1/2"	8 1/2"
3"	13 1/8"	4 3/4"	9 3/4"
4"	15"	4 7/16"	9 5/16"
6"	18 9/16"	4"	9"
8"	22 11/16"	5 1/4"	10 1/4"
10"	27"	6 7/8"	11 5/8"
12"	31 1/8"	8"	15"
14"	35 1/4"	12 1/2"	19 1/2"
16"	39 1/2"	14 1/2"	21 3/4"

Drawing Revision

Designer: PFB 01/23/12
Revised By: MWP 07/08/21

Disclaimer

Weights (lbs./kg) dimensions (inches/mm) and drawings provided for your guidance. We reserve the right to modify specifications without prior notice.

Contact

800 626 4653
ejco.com

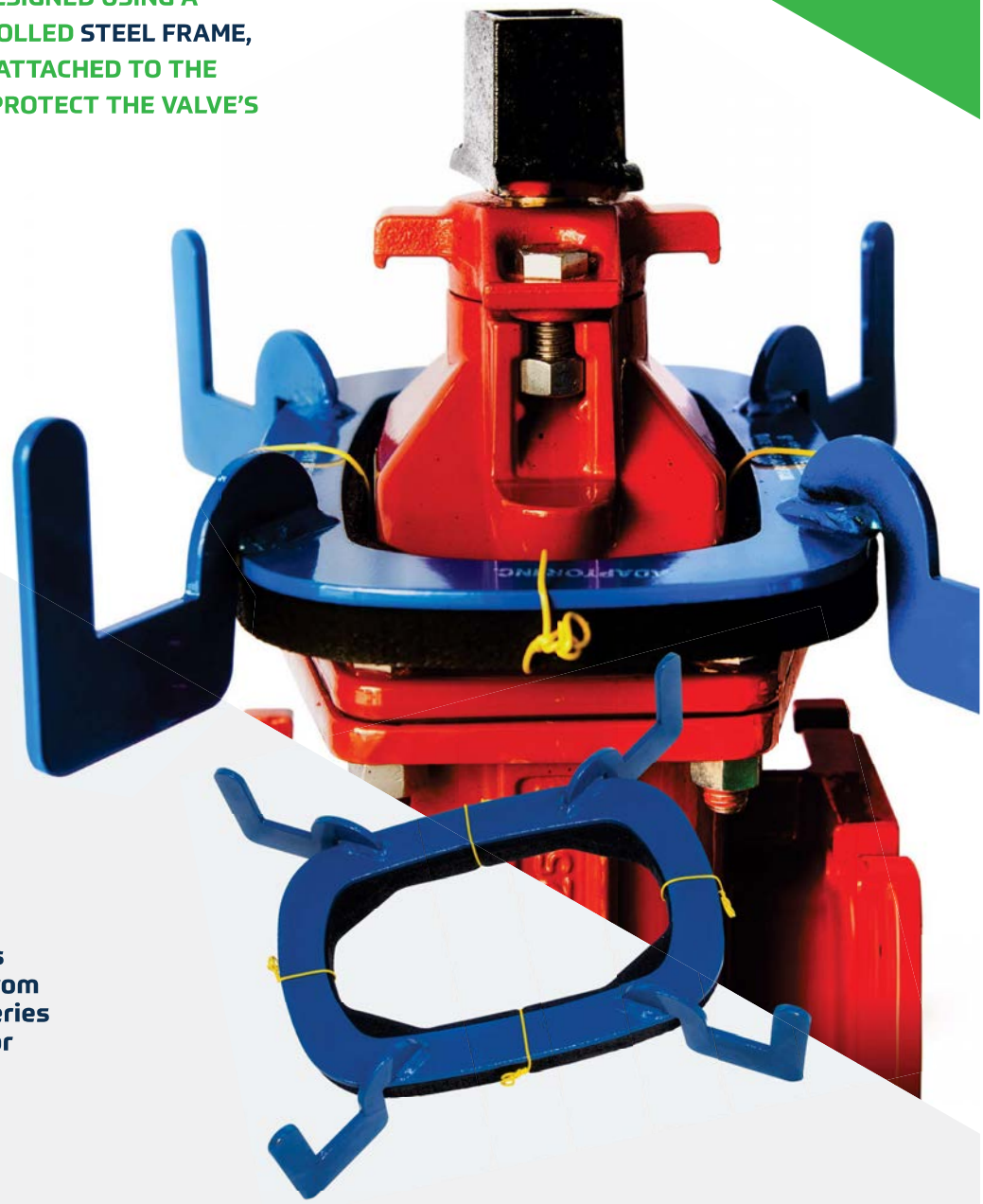
WD-11

WATER MAIN

GATE VALVE ADAPTOR

ADAPTOR

OUR ORIGINAL GATE VALVE ADAPTOR, AND STILL THE INDUSTRY LEADER, IS DESIGNED USING A POWDER COATED ¼" COLD-ROLLED STEEL FRAME, WITH A ¾" RUBBER GASKET ATTACHED TO THE BOTTOM OF THE FRAME TO PROTECT THE VALVE'S EPOXY COATING.



Advantages

- Steel frame
- Custom-fitted gasket
- Manufactured for all types and sizes of gate valves from 3" to 16" using the 6860 series #4 , #6 base valve boxes or the equivalent

CALL OR VISIT OUR WEBSITE TO LEARN MORE

2151 South 54th Street, West Allis, WI 53219 • office 414.764.6733 • fax 414.764.1494 • adaptorinc.com • American Made

2151 South 54th Street
West Allis, WI. 53219
P: 414-764-6733
F: 414-764-1494

Gate Valve Adaptor

Fits: 6 Base Valve Boxes

Size	SKU	Description	Weight
		Valve: Mueller/ U. S. Pipe	
3"	20092	Gate Valve Adaptor 3 Mue	8 LBS.
4"	20085	Gate Valve Adaptor 4 Mue, 4 KCM, 4 EJ	8 LBS.
6"	20086	Gate Valve Adaptor 6 Mue, 6 AFC	9 LBS.
8"	20059	Gate Valve Adaptor 8 Mue, 8 AFC	10 LBS.
10"	20060	Gate Valve Adaptor 10 Mue, 10 AFC, 10 KCM, 10 EJ	15 LBS.
12"	20089	Gate Valve Adaptor 12 Mue, 12 KCM	13 LBS.
16"	20099	Gate Valve Adaptor 16 Mue	22 LBS.
18" - 24"	70001	MULTI-FIT 18 - 24 Valves	12 LBS.
		Valve: Kennedy / Clow / M & H	
3"	20068	Gate Valve Adaptor 3 KCM	8 LBS.
4"	20085	Gate Valve Adaptor 4 Mue, 4 KCM, 4 EJ	8 LBS.
6"	20075	Gate Valve Adaptor 6 KCM, 6 AVK	8 LBS.
8"	20087	Gate Valve Adaptor 8 KCM, 8 AVK	9 LBS.
10"	20060	Gate Valve Adaptor 10 Mue, 10 AFC, 10 KCM, 10 EJ	10 LBS.
12"	20089	Gate Valve Adaptor 12 Mue, 12 KCM	13 LBS.
16"	20090	Gate Valve Adaptor 16 KCM	22 LBS.
18" - 24"	70001	MULTI-FIT 18 - 24 Valves	12 LBS.
		Valve: East Jordan Iron Works	
3" & 4"	20085	Gate Valve Adaptor 4 Mue, 4 KCM, 4 EJ	8 LBS.
6"	20070	Gate Valve Adaptor 6 EJ	9 LBS.
8"	20071	Gate Valve Adaptor 8 EJ	10 LBS.
10"	20060	Gate Valve Adaptor 10 Mue, 10 AFC, 10 KCM, 10 EJ	10 LBS.
12"	20061	Gate Valve Adaptor 12 EJ, 12 AFC	13 LBS.
16" - 24"	70001	MULTI-FIT 16 - 24 Valves	12 LBS.
		Valve: American Flow Control	
3"	20091	Gate Valve Adaptor 3 AFC, 3 AVK	8 LBS.
4"	20057	Gate Valve Adaptor 4 AFC, 4 AVK	8 LBS.
6"	20086	Gate Valve Adaptor 6 Mue, 6 AFC	9 LBS.
8"	20059	Gate Valve Adaptor 8 Mue, 8 AFC	10 LBS.
10"	20060	Gate Valve Adaptor 10 Mue, 10 AFC, 10 KCM, 10 EJ	10 LBS.
12"	20061	Gate Valve Adaptor 12 EJ, 12 AFC	13 LBS.
14" & 16"	20062	Gate Valve Adaptor 16 AFC	16 LBS.
18" - 24"	70001	MULTI-FIT 18 - 24 Valves	12 LBS.
		Valve: American AVK	
3"	20091	Gate Valve Adaptor 3 AFC, 3 AVK	8 LBS.
4"	20057	Gate Valve Adaptor 4 AFC, 4 AVK	8 LBS.
6"	20075	Gate Valve Adaptor 6 KCM, 6 AVK	8 LBS.
8"	20087	Gate Valve Adaptor 8 KCM, 8 AVK	9 LBS.
10"	20094	Gate Valve Adaptor 10 AVK	10 LBS.
12"	20095	Gate Valve Adaptor 12 AVK	15 LBS.
16" - 24"	70001	MULTI-FIT 16 - 24 Valves	12 LBS.

CAST IRON THREE-PIECE VALVE BOXES

for 3" through 20" valves, 5 1/4 shaft, screw type

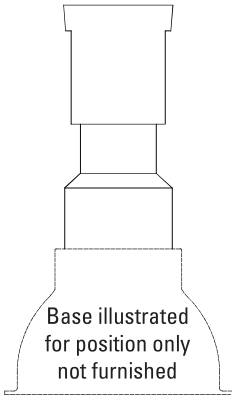
(Base required, order separately)

Tyler Union Valve boxes are available either assembled or as individual tops and bottoms.

NOTE: Domestic valve boxes available in Heavy Duty only. Non-Domestic available in Standard or Heavy Duty

6860 ASSEMBLED BOXES (LESS LID)						
Box (Components)	Extension Height	**(D-HD) UPC 670610	**(ND-HD) UPC 670610	Weight	**(ND-Std.) UPC 670610	Weight
AA (10T + 12B)	27–37	145912	–	42	136668	29
A (16T + 18B)	33–42	145929	–	65	136651	38
B (16T + 24B)	39–49	145936	–	69	136675	51
C (16T + 30B)	45–54	145943	–	73	136682	55
CC (16T + 36B)	51–60	145950	–	75	136699	59
D (26T + 30B)	45–66	145967	502357	88	136811	71
DD (26T + 36B)	51–72	145974	502364	90	136828	75
E (16T+24B+60 Ext)	63–72	145981	–	105	136835	80
F (26T+24B+60 Ext)	63–84	145998	–	120	136842	96
G (26T+36B+60 Ext)	74–94	146001	502371	126	136859	104

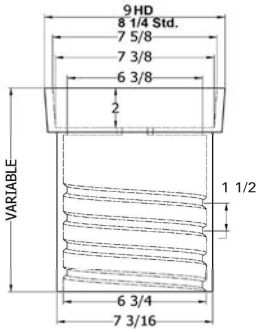
** D = Domestic ND = Import HD = Heavy Duty Weight Std. = Standard Weight



6860 Assembly
(Less Lid)

6860 INDIVIDUAL TOPS (LESS LID)							
Box	TOP Length	**(D-HD) UPC 670610	Weight	**(ND-HD) UPC 670610	Weight	**(ND-Std.) UPC 670610	Weight
AA	(10T)	144939	23	502142	23	112402	15
A	(10T)	144939	23	502142	23	112402	15
B	(16T)	144946	36	502159	36	112419	22
C	(16T)	144946	36	502159	36	112419	22
CC	(16T)	144946	36	502159	36	112419	22
D	(26T)	144953	51	502166	52	112426	38
DD	(26T)	144953	51	502166	52	112426	38
E	(16T)	144946	36	502159	36	112419	22
F	(26T)	144953	51	502166	52	112426	38
G	(26T)	144953	51	502166	52	112426	38

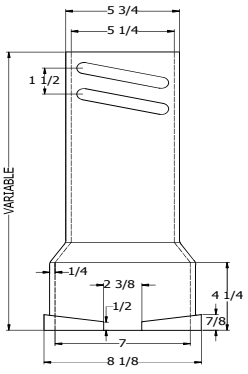
** D = Domestic ND = Import HD = Heavy Duty Weight Std. = Standard Weight



Top

6860 INDIVIDUAL BOTTOMS							
Box	Bottom Length	**(D-HD) UPC 670610	Weight	**(ND-HD) UPC 670610	Weight	**(ND-Std.) UPC 670610	Weight
AA	(12B)	145134	19	–	–	250524	14
A	(18B)	145141	29	505594	29	250517	25
B	(24B)	145158	33	502388	33	136958	29
C	(30B)	145165	37	502395	37	136613	33
CC	(36B)	145172	39	502401	39	136620	35
D	(30B)	145165	37	502395	37	136613	33
DD	(36B)	145172	39	502401	39	136620	35
E	(24B)	145158	33	502388	33	136958	29
F	(24B)	145158	33	502388	33	136958	29
G	(36B)	145172	39	502401	39	136620	35
–	(48B)	–	–	–	–	452713	65
–	(60B)	–	–	–	–	452720	91

** D=Domestic ND=Import HD=Heavy Duty Weight Std.=Standard Weight



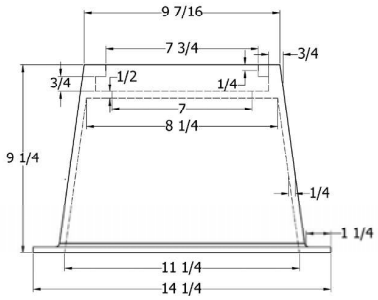
Bottom

See page 50 for extensions.

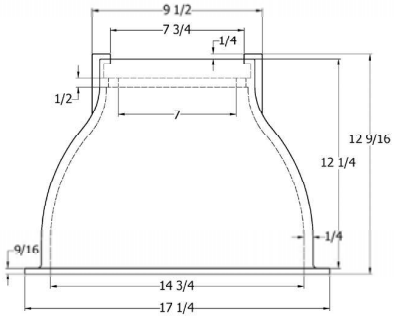
CAST IRON THREE-PIECE VALVE BOXES

for 3" through 20" valves, 5 1/4 shaft, screw type

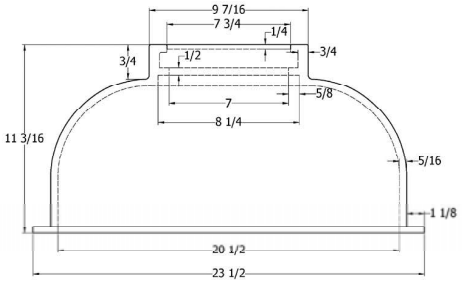
(Base required, order separately)



#4 Base



#6 Base



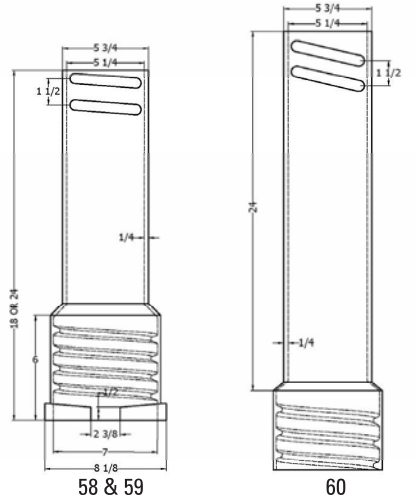
#160 Base

6860 BASES						
Item Description	**(D-HD) UPC 670610	Weight	**(ND)UPC 670610	Weight	**(ND-Std) UPC 670610	Weight
#4,11 1/4" Wide	145653	42	–	34	381532	22
#6,14 3/4" Wide	145660	38	502432	45	381525	36
#160, 20 1/2" Wide	145684	71	502425	68	256861	55

** D = Domestic ND = Import HD = Heavy Duty Weight Std. = Standard Weight

6850/60 EXTENSIONS							
Item/Description	Height Increase	**(D-HD) UPC 670610	Weight	**(ND-HD) UPC 670610	Weight	**(ND-Std.) UPC 670610	Weight
#58 Screw-Type	14	145141	32	505594	29	250517	23
#59 Screw-Type	18	145158	30	–	–	136958	29
#60 Screw-Type	24	145059	39	502210	36	112389	29

** D = Domestic ND = Import HD = Heavy Duty Weight Std. = Standard Weight

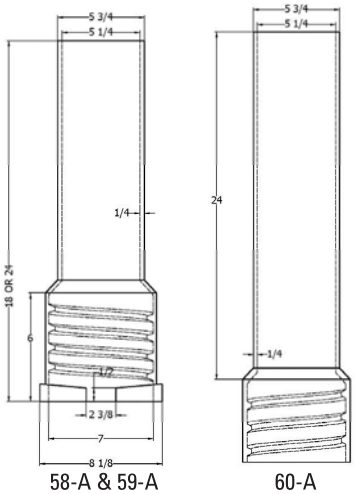


58 & 59 60

6855 EXTENSIONS					
Item/Description	Height Increase	**(D-HD) UPC 670610	Weight	**(ND-Std.) UPC 670610	Weight
#58-A Slip-Type	6-14	145233	29	136637	26
#59-A Slip-Type	6-18	145240	30	136644	28
#60-A Slip-Type	6-24	145066	36	112198	37

*NOTE: When intsalling these extensions, a 6850 screw type bottom is required.

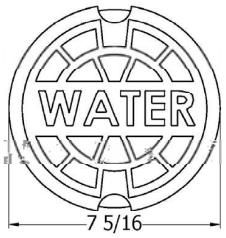
** D = Domestic ND = Import HD = Heavy Duty Weight Std. = Standard Weight



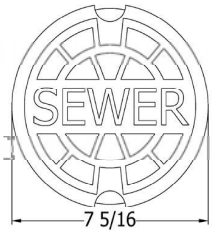
58-A & 59-A 60-A

DROP AND LOCK LIDS

Water Lid



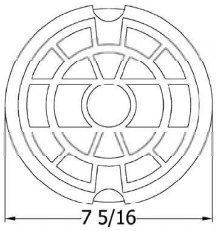
Sewer Lid

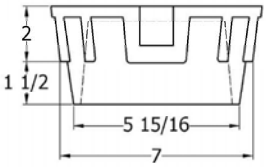


Gas Lid

Reuse Lid

Plain Lid

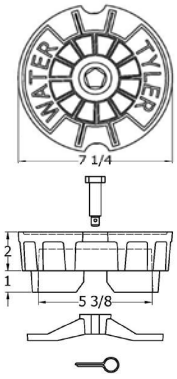




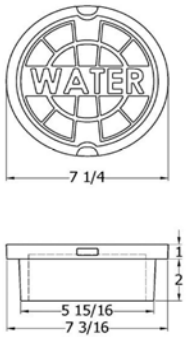
*5 1/4 DROP LID					
Item Description	**(D-HD) UPC 670610	Weight	**(ND)UPC 670610	Weight	Marking
5 1/4 Drop Lid	145325	12	136910	9	WATER
5 1/4 Drop Lid	145349	12	136903	9	SEWER
5 1/4 Drop Lid	145332	12	136873	9	GAS
5 1/4 Drop Lid	458975	12	–	–	REUSE
5 1/4 Drop Lid	145356	12	136897	9	PLAIN

** D = Domestic ND = Import HD = Heavy Duty Weight Std. = Standard Weight
*Lids marked WATER will be shipped unless otherwise specified.

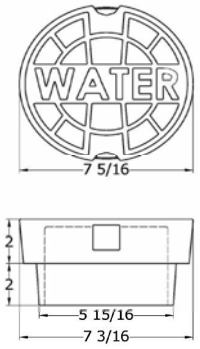
Lock Lid



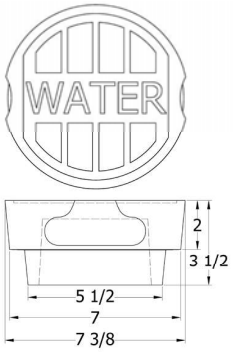
1 1/8" Lid



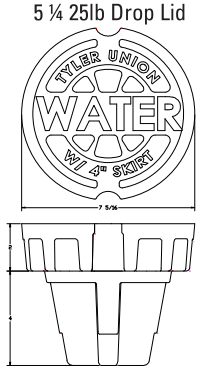
OMA Lid



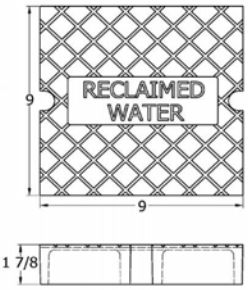
MWW Lid

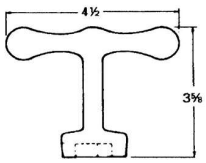


5 ¼ 25lb Drop Lid



***Square Reclaimed Lid



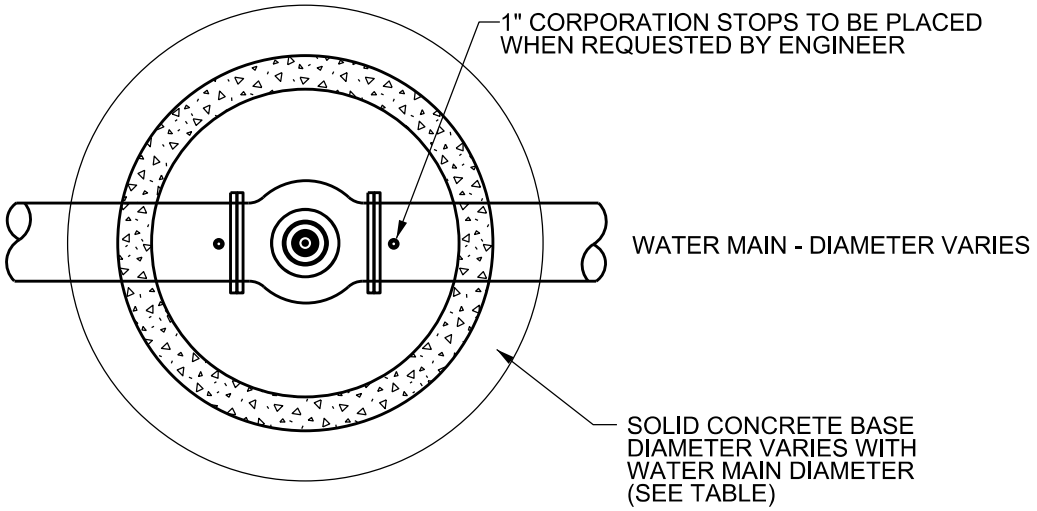


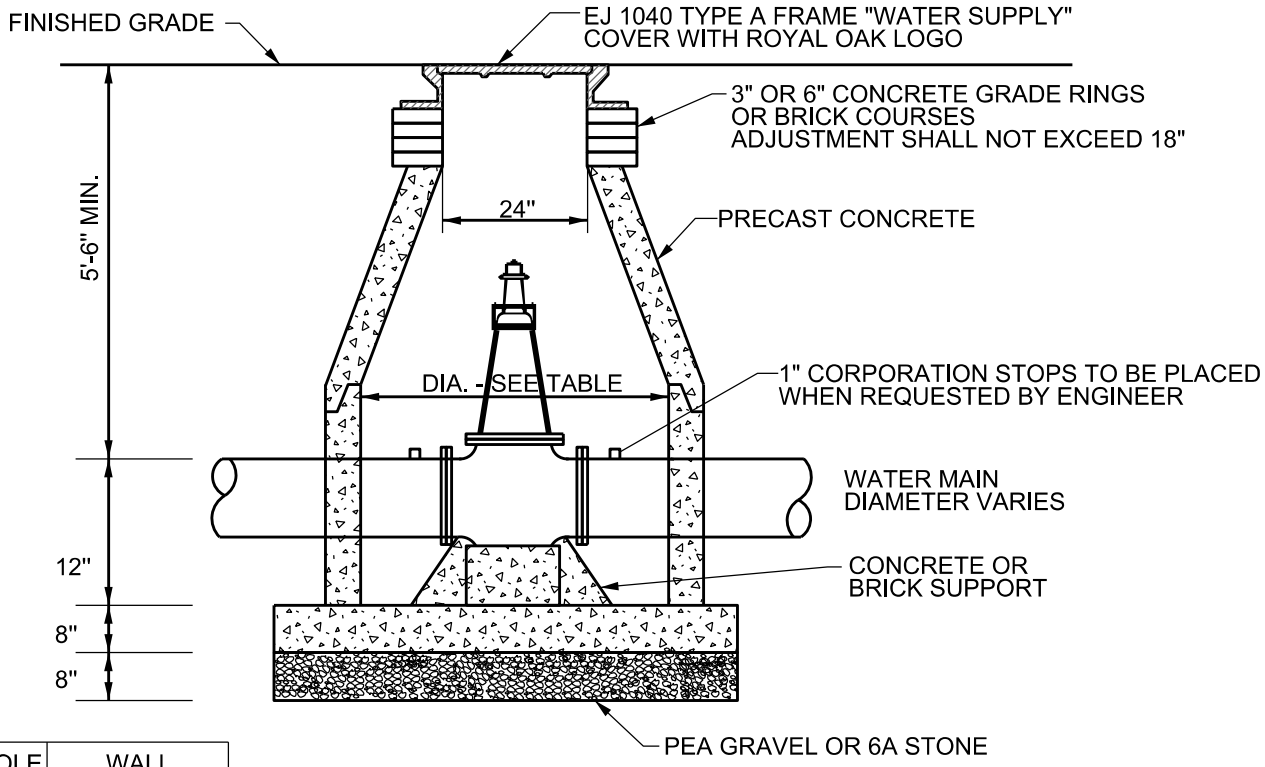
Wrench
Fits Standard Waterworks Pentagon Head 27/32" Brass Screws

WRENCH		
Description	UPC 670610	Weight
Wrench	144908	0.5

SPECIALTY LIDS					
Item Description	**(D-HD) UPC 670610	Weight	**(ND)UPC 670610	Weight	Marking
5 1/4 Lock Lid	145462	11	136866	11	WATER
*1 1/8 Lid	145509	11	112532	9	WATER
5 1/4 OMA Drop Lid	145370	12	136927	12	WATER
5 1/4 MWW Drop Lid	145370	12	136880	12	WATER
5 ¼ 25lb Drop Lid	145451	25	112632	–	WATER
***Square Drop Lid	458982	14	–	–	RECLAIMED WATER

*Note: Use with 1 1/8 riser only.
** D = Domestic ND = Non-Domestic HD = Heavy Duty Weight Std. = Standard Weight
***Note: Use with 9T Top #144622.





W.M. SIZE	MANHOLE DIA.	WALL THICKNESS
6"	5'	6"
8"	5'	6"
12"	6'	7"
16"	6'	7"

NOTE: MANHOLE CONCRETE BASE SHALL BE PLACED ON COMPACTED MATERIAL.

STANDARD GATE WELL

HYMAX 2

HYMAX®2 COUPLING
(1.5" - 12")

FEATURES

- ADVANCED WIDE-RANGE COUPLING WITH A PATENTED FLIP GASKET
- ELIMINATES GASKET REMOVAL MISTAKES AND MAXIMIZES INSTALLER WORK EFFICIENCY
- ONLY 2-4 TOP FACING BOLTS, FOR FASTER AND SAFER INSTALLATION
- READY-TO-USE DESIGN TO ELIMINATE EXTENSIVE UNDER-PIPE DIGGING
- ALLOWS 4° DYNAMIC DEFLECTION ON EACH END, REDUCING FUTURE PIPE DAMAGE
- PATENTED HYDRAULICALLY-ASSISTED GASKET WITH 2-STAGE SEALING
- SUITABLE FOR ALL TYPES OF PIPES - DUCTILE IRON, CAST IRON, STEEL, COPPER, PE, PVC, AC, GRP
- ONE PRODUCT CAN CONNECT PIPES OF TWO DIFFERENT MATERIALS
- BASED ON THE GAME-CHANGING HYMAX THAT HAS BEEN FIELD-PROVEN IN MILLIONS OF INSTALLATIONS IN THE US
- PRODUCT PERFORMANCE, OD RANGE AND PRESSURES ARE IDENTICAL TO THOSE OF THE ORIGINAL HYMAX
- LIFTING T-HANDLE EXISTS IN SIZES 3"-12" ONLY

SPECIFICATIONS

STANDARDS

HYMAX2 MEETS OR EXCEEDS STANDARDS AWWA C-219, NSF 61, NSF 372.

SIZE

AVAILABLE IN NOMINAL DIAMETER FROM 1.5" - 12" STANDARD. CALL KRAUSZ FOR DETAILS.

MATERIALS

END RINGS	ASTM A283 / A283M GRADE C STEEL.
CENTER RING	ASTM A53 GRADE A STEEL.
GASKETS	EPDM COMPOUNDED FOR WATER AND SEWAGE, MEETS INTERNATIONAL STANDARDS FOR CONTACT WITH DRINKING WATER.
BRIDGE	AVAILABLE IN AISI 304 OR SS316* STAINLESS STEEL
SPHERICAL SPACERS	AVAILABLE IN AISI 304 OR SS316* STAINLESS STEEL
COATING	100% FUSION BONDED EPOXY FOR ENHANCED CORROSION PROTECTION. AVERAGE THICKNESS 14 MIL.
NUTS & BOLTS	AVAILABLE IN AISI 304 OR SS316* STAINLESS STEEL. ROLLED THREAD AND ANTI-GALLING COATING.

* SS316 - Coming Soon

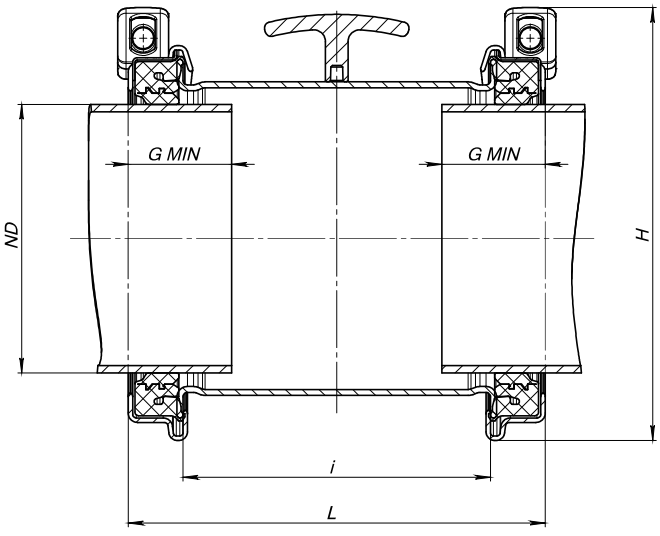
HYMAX®
Repair the past. Connect the future.
KRAUSZ is the creator of HYMAX

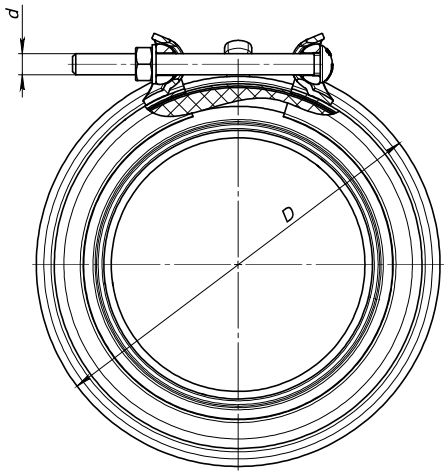
HYMAX 2

PRODUCT PERFORMANCE

WORKING TEMPERATURE	-20°F UP TO +125°F
DYNAMIC DEFLECTION	UP TO 4° PER SIDE
MIN. PIPE INSERTION	2.25"
MAXIMUM OFFSET FOR MISALIGNED PIPES	ND 1.5" - ND 3" 0.39" ND 4" - ND 12" 0.51"
MAXIMUM OUT OF ROUNDNESS	ND 1.5" 0.08″ ND 2" - ND 3" 0.20" 4" - 12" 0.31"
WORKING PRESSURE	260
RATED PRESSURE	390
VACUUM TEST	12 PSI

PRODUCT TABLES





HYMAX 2

PRODUCT TABLES

HYMAX®2 NOMINAL SIZES (1.5" - 12")

When XX = 54 - Fasteners are AISI 304
When XX = 94 - Fasteners are SS316*

Krausz Part Number	Nominal Diameter (inch)	Overall Range (inch)	Range in closed gasket position (inch)	Range in open gasket position (inch)	Bolt Qty. and Size (mm)	Torque (Ft-Lbs)	Approx. Weight (Lbs)	Length (inch)
860-XX-0041-16	1.5	1.61-2.13	1.61-1.97	1.96-2.13	2 -M12	35	5	6.1
860-XX-0054-16	2	2.10-3.03	2.10-2.60	2.56-3.03	2 -M12	50	7.5	6.8
860-XX-0088-16	3	3.46-4.33	3.46-3.90	3.86-4.33	2 -M12	50	10.8	8.8
860-XX-0108-16	4	4.25-5.63	4.25-5.00	4.92-5.63	2 -M14	75	15	8.8
860-XX-0130-16	5	5.12-6.38	5.12-5.75	5.71-6.38	2 -M14	75	19	10.8
860-XX-0163-16	6	6.42-7.68	6.42-7.05	7.01-7.68	2 -M14	75	23	10.8
860-XX-0190-16	7	7.48-8.74	7.48-8.11	8.07-8.74	2 -M14	75	24	10.8
860-XX-0217-16	8	8.54-9.84	8.54-9.17	9.13-9.84	2 -M14	75	28	10.8
860-XX-0272-16	10	10.70-12.00	10.70-11.37	11.33-12.00	2 -M14	75	32	10.8
860-XX-0278-16	10	10.96-12.26	10.96-11.63	11.59-12.26	2 -M14	75	33	10.8
860-XX-0315-16	12	12.40-13.66	12.40-13.03	12.99-13.66	2 -M14	80	39	10.8
860-XX-0334-16	12	13.15-14.41	13.15-13.78	13.74-14.41	2 -M14	80	39	10.8

For specific sizes of products in stock, call Krausz for details.

* SS316 Coming Soon

ALPHA™ RESTRAINED JOINT
EXTENDED RANGE COUPLING

SUBMITTAL INFORMATION

Certified to NSF/ANSI 61 & 372

USE

Provides a Restrained Joint for multi-purpose use from IPS PVC through Cast iron. The ALPHA can accommodate up to 4 degrees of deflection per end. The XL may have limited deflection at the top of the range (2 degrees max each end).

MATERIALS

CASTINGS
All cast components (end rings, center ring, and bolt guides) are ductile iron, meeting or exceeding the requirements of ASTM A 536, grade 65-45-12.

GRIPPERS
Ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12. Machine sharpened and heat treated. Xylan 1424 coated for superior corrosion resistance.

GASKETS
SBR compounded for water and sewer service per ASTM D2000, classified by UL to meet NSF61 or NBR compounded for water and sewer service per ASTM D2000, NSF61 Certified. Other compounds available upon request.

DRAW HOOKS
Uncoated 304 stainless steel.

RAMP RUNNERS
Nylon 66, Black, 14% Glass filled

BOLTS AND NUTS
5/8-11 bolts with heavy hex nuts. E-coated nuts, 304 stainless steel. Fasteners provided with anti-galling protection. 316 stainless steel available by request.

COATINGS
Center ring is Romacote fusion bonded epoxy, NSF 61 Certified. End rings are Romabond polyester.

PRESSURE

When properly installed, the Romac ALPHA coupling can be used at a working pressures equal to the rating of the installed pipe up to 350 psi.

PIPE MATERIALS

The Romac ALPHA series couplings can be used on DI, Oversized Cast Iron, PVC (IPS, C900, C909), and HDPE size 4"-12" (SDRs 9, 11, 13.5 and 17). Stiffener not required.

SIZES & RANGES

See catalog.

This information is based on the best data available at the date printed above. Please check with Romac for any updates or changes.

10/02/2020
Document # 20-8-0040

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MUELLER® BR2S & BR2W SERIES BRONZE SERVICE SADDLES - DOUBLE STRAP

Rev. 8-19 Shaded area indicates change

Mueller® Service Saddles for use on A-C, cast iron, ductile iron, and AWWA C900 PVC plastic pipe

- Outlet tapped with either AWWA taper (C.C.) or AWWA I.P. thread (F.I.P.T.)
- For use on A-C pipe, cast iron or ductile iron pipe and cast iron O.D. PVC pipe
- 200 psig (1380 kPa/14 barg) maximum working pressure
- Available in double strap designs
- Brass body
- 304L stainless steel straps
- Rolled strap threads
- O-ring sealed outlet
- 3/4" thru 2" tap sizes (1/2" and 5/8" some styles)
- Meets all applicable parts of ANSI/AWWA C800
- NSF 61 Certified

BR 2 S Series

BR 2 W Series

Mueller Service Saddles with Stainless Steel Double Straps

Pipe O.D. Range*		Kind and Size of Pipe			Stainless Steel Double Straps							
Inch	mm	A-C	Cast or Ductile Iron, C900 PVC	Tap*** Thread	Base Catalog Number	Size of Tapping (add to "Base" to complete catalog number)						
						1/2"	5/8"	3/4"	1"	1-1/4"	1-1/2"	2"
4.74-5.32	120.4-135.1		4"	CC or IP	BR2S0474	050	062	075	100	-	-	-
4.74-5.10	120.4-129.5		4"	CC or IP	BR2S0474	-	-	-	-	125	150	200
5.10-5.40	129.5-137.1		4"	CC or IP	BR2S0510	-	-	-	-	125	150	200
6.84-7.45	173.7-189.2		6"	CC or IP	BR2S0684	050	062	075	100	125	150	200
8.99-9.67	228.4-245.6		8"	CC or IP	BR2S0899	050	062	075	100	125	150	200
11.04-12.12	280.4-307.8	**	10"	CC or IP	BR2S1104	050	062	075	100	125	150	200
13.14-14.58	333.8-370.3		12"	CC or IP	BR2S1314	050	062	075	100	125	150	200
15.22-16.88	386.6-428.7		14"	CC or IP	BR2S1522	-	-	075	100	-	150	200
17.32-19.19	439.9-487.4		16"	CC or IP	BR2S1732	-	-	075	100	-	150	200
18.00-19.50	457.2-495.3		18" X	CC or IP	BR2W1800	-	-	075	100	125	150	200
20.00-21.60	508.0-548.6		20" X	CC or IP	BR2W2000	-	-	075	100	125	150	200
24.00-25.80	609.6-655.3		24" X	CC or IP	BR2W2400	-	-	075	100	125	150	200

**A-C pipe, classes 150-200 per ASTM C295 and AWWA C400 – actual O.D. of pipe being used must fall within the pipe O.D. range listed in the preceding charts. Centrifugally cast pipe, classes 50-250 per ANSI/AWWA C102/A21.2; ANSI/AWWA C106/A21.6; ANSI/AWWA C108/A21.8, and Federal specification WW-P-421. Ductile iron pipe, classes 50-56 per ANSI/AWWA C151/A21.51; Cast iron O.D. PVC plastic pipe per AWWA C900.*

*** The outside diameter of A-C pipe varies from manufacturer to manufacturer., to make certain you select the proper clamp: 1) Determine the O.D. of the pipe at the point of saddle installation; 2) From the pipe O.D. range column of the above chart, choose a saddle that has a pipe O.D. range that includes the determined pipe diameter.*

****CC=AWWA Taper; IP=AWWA IP thread (F.I.P.T)*

X – 18", 20" and 24" Saddles are provided with the 'W" Double Wide Strap

These machines may be used with the service saddles illustrated on this page

Machine	Service Saddle Tap Size						
	1/2"	5/8"	3/4"	1"	1-1/4"	1-1/2"	2"
E-5™	X	X	X	X	X	X	X
D-5™	-	-	X	X	X	X	X
TRU-CUT™	-	-	X	X	-	-	-
MEGA-CUT™	X	X	X	X	X	X	X
PL-2™	-	-	X	X	-	-	-

TO ORDER SPECIFY QUANTITY, OUTLET TAPPING SIZE AND CATALOG NUMBER

⚠ *WARNING: Use on A-C pipe, which contains a known carcinogen, requires appropriate protective equipment and procedures be employed.*

MUELLER® DR2S SERIES DUCTILE IRON SERVICE SADDLES - DOUBLE STRAP

Rev. 8-19 Shaded area indicates change

Nylon Ductile Iron Service Saddles for use on cast iron, ductile iron AWWA C900 PVC plastic, steel and A-C pipe.

- Outlet tapped with AWWA taper (C.C.) or AWWA I.P. thread (F.I.P.T.)
- Double strap design rated at 500 psig (3450 kPa/34.50 bar) maximum working pressure
- ASTM A536 ductile iron body
- Body is Nylon 11 (10 -12 mil)
- 304L stainless steel strap
- Rolled strap threads
- Nitrile O-ring gasket
- 1/2" thru 2" tap sizes
- Meets all applicable parts of ANSI/AWWA C800
- NSF 61 Certified

DR 2 S Series

DR 2 W Series

Mueller® Service Saddles with Double stainless steel strap

Pipe O.D. Range*		Kind and Size of Pipe				Double Stainless Steel Straps						
							Size of Tapping (add to "Base " to complete catalog number)					
Inch	mm	A-C	Std. Steel IPS PVC	Cast Iron, Ductile Iron PVC C900	Tap*** Thread	Base Catalog Number	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
2.35-2.50	59.7-63.5		2"	2"*	CC or IP	DR 2 S 0235	050	075	100	-	-	-
3.56-4.00	91.0-101.0		3-1/2"	3"	CC or IP	DR 2 S 0356	050	075	100	-	-	-
4.47-5.32	113.5-135.1		4"	4"	CC or IP	DR 2 S 0447	050	075	100	125	150	200
6.59-7.37	167.4-187.4		6"	6"	CC or IP	DR 2 S 0659	050	075	100	125	150	200
8.54-9.79	216.9-248.7		8"	8"	CC or IP	DR 2 S 0854	050	075	100	125	150	200
10.64-12.12	270.3-307.8	**	10"	10"	CC or IP	DR 2 S 1064	050	075	100	125	150	200
12.62-14.38	320.5-365.3		12"	12"	CC or IP	DR 2 S 1262	050	075	100	125	150	200
17.40-18.80	442.0-477.5		-	16"	CC or IP	DR 2 S 1740	-	075	100	125	150	200
18.00-19.50	457.2-495.3		-	18" X	CC or IP	DR 2 W 1800	050	075	100	125	150	200
20.00-21.60	508.0-548.6		-	20" X	CC or IP	DR 2 W 2000	050	075	100	125	150	200
24.00-25.80	609-655.3		-	24" X	CC or IP	DR 2 W 2400	050	075	100	125	150	200

** Important – carefully check the range of the saddle with the O.D. of the pipe being used.*
*** The outside diameter of A-C pipe varies from manufacturer to manufacturer. To make certain you select the proper clamp:*
1) Determine the O.D. of the pipe at the point of saddle installation;
2) From the pipe O.D. range column of the above chart, choose a saddle that has a pipe O.D. range that includes the determined pipe diameter.
3) Ductile Iron Double Stainless Strap Saddles can be specifically sized for IPS PVC or C900.
****CC=AWWA Taper; IP=AWWA IP thread (F.I.P.T)*
X – 18", 20" and 24" Saddles are provided with the "W" Double Wide Strap

These machines may be used with the service saddles illustrated on this page

Machine	Service Saddle Tap Size					
	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
E-5™	X	X	X	X	X	X
D-5™	-	X	X	X	X	X
TRU-CUT™	-	X	X	-	-	-
MEGA-CUT™	X	X	X	X	X	X
PL-2™	-	X	X	-	-	-

TO ORDER SPECIFY QUANTITY, OUTLET TAPPING SIZE AND CATALOG NUMBER

⚠ *WARNING: Use on A-C pipe, which contains a known carcinogen, requires appropriate protective equipment and procedures be employed.*

Ground Key Corporation Valve
Inlet: AWWA taper
(Mueller “CC”) thread
Outlet: Mueller®
INSTA-TITE® Connection for CTS PE tubing*

H-15006N

3/4"	3/4" x1" ‡	1"

Ground Key Corporation Valve
Inlet: AWWA I.P. thread
Outlet: Mueller®
INSTA-TITE ® Connection for CTS PE tubing*

H-15024N

3/4"	1"

Ground Key Corporation Valve
Inlet: AWWA taper
(Mueller “CC”) thread
Outlet: Mueller
INSTA-TITE Connection for IPS PE pipe*

H-15005N

3/4"	3/4" x1" ‡	1"

Ground Key Corporation Valve
Inlet: AWWA I.P. thread
Outlet: Mueller
INSTA-TITE Connection for IPS PE pipe*

H-15026N

3/4"	1"

Ground Key Corporation Valve
Inlet: AWWA taper
(MUELLER “CC”) thread
Outlet: Copper flare straight connection

H-15000N

5/8"	1/2"‡	5/8" x 3/4"	3/4"	3/4" x 1"	1"
1-1/4"	1-1/2"	1-1/2"x2"		2"	

Ground Key Corporation Valve
Inlet: AWWA I.P. thread
Outlet: Copper flare straight connection

H-15025N

1/2"	3/4"	1"	1-1/4"	1-1/2"	2"

Ground Key Corporation Valve
Inlet: AWWA taper
(Mueller “CC”) thread
Outlet: Copper flare eighth bend connection

H-15010N

3/4"	1"	1-1/2"	2"

Ground Key Corporation Valve
Inlet: AWWA I.P. thread
Outlet: Copper flare eighth bend connection

H-15035N

3/4"‡	1"‡	1-1/2"	2"

Ground Key Corporation Valve
Inlet: AWWA taper
(Mueller “CC”) thread
Outlet: Copper flare quarter bend connection

H-15020N

5/8"x3/4"	3/4"	3/4"x1"	1"	1-1/2"	2"

Ground Key Corporation Valve
Inlet: AWWA I.P. thread
Outlet: Copper flare quarter bend connection

H-15045N

3/4"‡	1"	1-1/2"	2"

**See charts on pages 5.12-5.16 for tubing and pipe that may be used on these connections.*
‡ Requires minimum ordering quantity. Contact MUELLER Customer Service Center for minimum order requirements and availability.
NOTE: Sizes shown above represent nominal size of inlet and outlet connections. When two sizes are given, the first is size of inlet and the second is size of outlet.

Mueller Corporation Valves are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

SERVICE FITTINGS WITH COPPER FLARE CONNECTION

Rev. 4-14 Shaded area indicates changes

Two Part Union
Copper flare nut x female copper flare thread

H-15405N

3/4"	1"	1-1/2"	2"

Eighth bend coupling
Copper flare nut x F.I.P.

H-15455N

3/4"	1" ‡

Straight three part union
Copper flare nut**–both ends**

H-15400N

1/2"	5/8"	5/8" x 1/2"	5/8" x 3/4"	3/4"	3/4" x 1/2"
3/4" x 1"	1"	1-1/4"	1-1/4' x 1"	1-1/2"	2"

Quarter bend coupling
Copper flare nut x F.I.P.

H-15460N

3/4"	1"	1" x 3/4"	1-1/4"‡	1-1/2"‡	2"

Eighth bend three part union
Copper flare nut**–both ends**

H-15522N

3/4"	1"

Straight coupling
Copper flare nut x M.I.P.

H-15425N

1/2"‡	1/2" x 3/4"		5/8" x 3/4"	3/4"	5/8" x 1/2"	3/4" x 1/2"
3/4" x 1"	1"	1" x 3/4"	1" x 1-1/4"‡	1-1/4"	1-1/2"	2"

Quarter bend three part union
Copper flare nut**–both ends**

H-15525N

3/4"	3/4" x 1"	1"	1-1/2"	2"

Quarter bend coupling
Copper flare nut x M.I.P.

H-15530N

1/2"‡	3/4"	3/4" x 1"	1"	1" x 3/4"	1-1/2"‡	2"

Straight coupling
Copper flare nut x F.I.P.

H-15450N

1/2"	1/2" x 3/4"‡	5/8" x 3/4"	3/4"	3/4" x 1/2"	1"
1" x 3/4"	1-1/4"	1-1/2"	2"		

Eighth bend coupling
M.I.P x copper flare nut

H-15539N

3/4"	1"

NOTE: Sizes shown above represent normal size of fitting. When two sizes are given, the first is size of copper flare nut and second is size of threaded end.
‡Requires minimum ordering quantity. Contact MUELLER Customer Service Center for minimum ordering requirements and availability.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

Eighth bend coupling
Swivel nut with female copper flare thread x copper flare nut

H-15064N

3/4"	1"	1-1/2"	2"

Eighth bend coupling
Swivel nut with female Mueller® Coupling thread x copper flare nut

H-15486N

3/4"	1"

Quarter bend coupling
Swivel nut with female copper flare thread x copper flare nut

H-15069N

3/4"	1"	3/4" x 1"	1-1/2"	2"

Quarter bend coupling
Swivel nut with female Mueller Coupling thread x copper flare nut

H-15491N

3/4"	3/4" x 1"	1"

Eighth bend coupling
Swivel nut with female increasing I.P. thread (this thread is one size larger than nominal size of fitting) x copper flare nut

H-15471N

3/4"	1" ‡

Straight coupling
Female copper flare thread x copper flare nut

H-15062N

3/4"x1"	1"x3/4"	1"x1-1/4"

Quarter bend coupling
Swivel nut with female increasing I.P. thread (this thread is one size larger than nominal size of fitting) x copper flare nut

H-15476N

3/4"	1"

Eighth bend coupling
Female copper flare thread x copper flare nut

H-15063N

3/4"	1"	1-1/2"	2"

Note: Sizes shown above represent nominal size of fitting. When two sizes are listed, the first is the size of threaded end and the second is size of copper flare nut.
‡Requires minimum ordering quantity. Contact MUELLER Customer Center for minimum order requirements and availability.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

SERVICE FITTINGS WITH COPPER FLARE CONNECTION

Rev. 11-19 Shaded area indicates changes

Quarter bend coupling
Female copper flare thread x copper flare nut

H-15068N

3/4"	1"	1"x3/4"	1-1/4" ‡	1-1/2"	2"

Straight coupling Female
Mueller® Coupling thread x copper flare nut

H-15480N

1/2"x 3/4"	5/8"x 3/4"	3/4"	3/4" x 1"	1"	1" x 3/4"

Straight coupling
Female increasing I.P.thread (this thread is one size larger than nominal size of fitting) x copper flare nut

H-15465N

3/4"	1-1/2"‡

Eighth bend coupling
Female Mueller Coupling thread x copper flare nut

H-15485N

1/2"x3/4"	5/8"x3/4"	5/8" x 1"	3/4"	3/4"x1"	1"	1"x3/4"

Eighth bend coupling
Female increasing I.P. thread (this thread is one size larger than nominal size of fitting) x copper flare nut

H-15470N

3/4"	1"	1-1/4"	1-1/2"	2"

Quarter bend coupling
Female Mueller Coupling thread x copper flare nut

H-15490N

1/2"x3/4"	5/8"x3/4"	3/4"	1"	1"x3/4"

Quarter bend coupling
Female increasing I.P. thread (this thread is one size larger than nominal size of fitting) x copper flare nut

H-15475N

3/4"	1"

Quarter bend coupling
Internal swivel connection for 110 compression or pack joint CTS x copper flare nut

H-15551N

3/4"	1"

Straight coupling
Female copper flare thread x M.I.P. thread

H-15098N

3/4"	1"

Straight coupling
Female copper flare thread x F.I.P. thread

H-15082N

3/4"	1"	1-1/2"	2"

NOTE: Sizes shown above represent nominal size of fitting. When two sizes are listed, the first is the size of the threaded end and the second is size of copper flare nut.
‡Requires minimum ordering quantity. Contact MUELLER Customer Service Center for minimum order requirements and availability.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

Straight union
Extra strong (XS) lead flange coupling x copper flare nut

H-15506N

1/2"	1/2" x 3/4"	5/8" x 3/4"	3/4"	3/4" x 5/8"

Eighth bend coupling
Swivel nut with female extra strong (XS) lead flange thread x copper flare nut

H-15516N

5/8" x 3/4"	3/4"	2"

Straight coupling
Female extra strong (XS) lead flange thread x copper flare nut

H-15505N

1/2"	1/2" x 3/4"		5/8"	5/8" x 3/4"	3/4"
3/4" x 1"	1"	1" x 3/4"	1-1/4" x 1"	1-1/2"	2"

Straight coupling
Female double extra strong (XXS) lead flange thread x copper flare nut

H-15510N

5/8" x 3/4"	3/4"	2"

Eighth bend coupling
Female extra strong (XS) lead flange thread x copper flare nut

H-15515N

5/8" x 3/4"	3/4"	1"

Quarter bend coupling
Female extra strong (XS) lead flange thread x copper flare nut

H-15513N

1/2"x3/4"	5/8"x3/4"	3/4"	1"‡	1"x3/4"

Quarter bend coupling
Female extra strong (XS) lead flange thread x copper flare nut (pre-1920)

H-15513-03N

1"x3/4"

Eighth bend coupling
Female double extra strong (XXS) lead flange thread x copper flare nut

H-15521N

1/2" x 3/4"	3/4"

NOTE: Sizes shown above represent nominal size of fitting. When two sizes are given, first is size of lead flange end and second is size of copper flare nut.
‡Requires minimum ordering quantity. Contact MUELLER Customer Service Center for minimum ordering requirements and availability.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

H-15403N

Straight three part union
Mueller 110® Conductive Compression Connection for CTS O.D.* tubing-**both ends**

1/2"	1/2"x3/4"	5/8"x3/4"	5/8"	3/4"	1"	
1"x3/4"	1-1/4"	1-1/4"x1"	1-1/2"	1-1/2"x1"	2"	

H-15428N

Straight coupling
Mueller 110 Conductive Compression Connection for CTS O.D.* tubing x M.I.P. thread

1/2"‡	1/2" x 3/4"	5/8" x 3/4"	3/4"	3/4" x 1/2"	3/4" x 1"
1"	1" x 3/4"	1-1/4"	1-1/4" x 1"		1-1/2"
1-1/2" x 1"		1-1/2" x 2"	1" x 2"	2"	2" x 1-1/2"

H-15404N

Straight three part union
Mueller 110® Compression Connection for IPS PE* pipe-**both ends**

3/4"	1"	1"x3/4"

E-15409N

Straight coupling
Mueller 110 Conductive Compression Connection for CTS O.D. tubing x Pack Joint Connection for IPS PE pipe
***Note: 3/4" size only may also be used on PVC*

3/4"**	3/4"x1"	1"	1"x3/4"

H-15413N

Straight Female coupling
Mueller Coupling Thread Swivel x 110 CTS Conductive Compression Connection for CTS O.D.

1"

H-15451N

Straight coupling
Mueller 110 Conductive Compression Connection for CTS O.D.* tubing x F.I.P. thread

1/2"	1/2" x 3/4"	5/8" x 3/4"	3/4"	3/4" x 1/2"	3/4" x 1"
1"	1" x 3/4"	1" x 1-1/4"	1-1/4"	1-1/4" x 1"	1-1/2"
1-1/2" x 1"		2"	2" x 1-1/2"		

H-15429N

Straight coupling
Mueller 110 Compression Connection for IPS PE* pipe x M.I.P. thread

3/4"	1"	1"x3/4"

H-15409N

Straight coupling three part union
Mueller 110 Conductive Compression Connection for CTS O.D.* tubing x 110 Compression Connection for IPS PE* pipe

3/4"	3/4"x1"	1"	1"x3/4"

H-15454N

Straight coupling
Mueller 110 Compression Connection for IPS PE* pipe x F.I.P. thread

3/4"	1"	1"x3/4"

H-15079N

Straight coupling
Mueller 110 Conductive Compression Connection for CTS O.D. tubing x copper flare nut

3/4"	1"

**See chart on page 6.11 for tubing and pipe that may be used with these connections.*
‡Requires minimum ordering quantity. Contact MUELLER Customer Service Center for minimum ordering requirements and availability.
NOTE: Sizes shown above represent nominal size of fitting. When two sizes are given, first is size of MUELLER 110 Compression Connection and second is size of threaded end.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

B-25209N

Mueller 300 Ball Curb Valve
Mueller 110 Conductive Compression Connection for CTS O.D.* tubing - **both ends**.
Quarter turn check - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25209-3)

3/4"R	3/4"	1"R	1"	1-1/2"	1-1/2"x2"	2"

B-25155N

Mueller 300 Ball Curb Valve
Mueller 110 Conductive Compression Connection for CTS O.D.* tubing - **both ends**.
Quarter turn check and Minneapolis top thread - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25155-3)

3/4"	1"	1-1/2"	2"

B-25210N

Mueller 300 Ball Curb Valve
Inlet: Mueller 110 Conductive Compression Connection for CTS O.D.* tubing
Outlet: Mueller 110 Compression Connection for IPS PE* pipe
Quarter turn check - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25210-3)

3/4"	1"

B-25152N

Mueller 300 Ball Curb Valve
Inlet: Mueller 110 Conductive Compression Connection for CTS O.D.* tubing
Outlet: Mueller 110 Compression Connection for IPS PE* pipe
Minneapolis top thread - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25152-3)

3/4"	1"

B-25211N

Mueller 300 Ball Curb Valve
Mueller 110 Conductive Compression Connection for IPS PE* pipe - **both ends**.
Quarter turn check-this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25211-3)

3/4"	1"

B-25219N

Mueller 300 Ball Curb Valve
Mueller 110 Conductive Compression Connection for CTS O.D.* tubing with drain - **both ends**.
This valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25219-3)

3/4"	1"	1-1/2"	2"

B-25222N

Mueller 300 Ball Curb Valve
Inlet: Mueller 110 Conductive Compression Connectionfor IPS
PE* - both ends.
Quarter turn check-this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25222-3)

1"

B-25218N

Mueller 300 Ball Curb Valve
Inlet: Mueller 110 Conductive Compression Connection for IPS with drain
PE* - both ends.
Minneapolis top thread - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25118-3)

1"

B-25122N

Mueller 300 Ball Curb Valve
Inlet: Mueller 110 Conductive Compression Connection for CTS O.D.* tubing
Outlet: M.I.P. thread.
Quarter turn check - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25122-3)

3/4"R	3/4"	3/4"x1"	1"R	1"	1-1/2"	2"

B-25171N

Mueller 300 Curb Valve
Inlet: Mueller 110 Compression Connection for IPS PE* pipe
Outlet: F.I.P. thread
Quarter turn check - this valve may be ordered with 360° turn option by adding -3 to end of catalog number (B-25171-3)

3/4"	1"

**See page 7.18 for tubing and pipe that can be used with this connection.*
NOTE: Sizes shown above represent nominal size of valve. "R" means Reduced port. Ball waterway is one nominal size smaller than inlet/outlet.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

Mueller MARK II ORISEAL Curb Valve
Copper flare nut - **both ends**
Quarter turn check

H-15204N

3/4"	1"	1-1/4"	1-1/2"	2"

NOTE: 3/4" and 1" sizes are NOTE: 3/4" and 1" sizes are bi-directional and can be installed with flow from either direction. Sizes larger than 1" are one way flow and must be installed with flow as indicated by arrow and in/out lettering cast on valve body.

Mueller MARK II ORISEAL Curb Valve
Copper flare nut - **both ends**
Quarter turn check and drain

H-15214N

3/4"	1"	1-1/4"	1-1/2"	2"

Mueller MARK II ORISEAL Curb Valve
Copper flare nut - **both ends**
Quarter turn check and Minneapolis thread top

H-15154N

3/4"	1"	1-1/4"	1-1/2"	2"

NOTE: 3/4" and 1" sizes are bi-directional and can be installed with flow from either direction. Sizes larger than 1" are one way flow and must be installed with flow as indicated by arrow and in/out lettering cast on valve body.

Mueller MARK II ORISEAL Curb Valve
Copper flare nut - **both ends**
Quarter turn check, Minneapolis thread top and drain

H-15164N

3/4"	1"	1-1/4"	1-1/2"	2"

Mueller MARK II ORISEAL Curb Valve
Inlet: Copper flare nut
Outlet: F.I.P. thread
Quarter turn check

H-15174N

3/4"	1"	1-1/4"	1-1/2"	2"

NOTE: 3/4" and 1" sizes are bi-directional and can be installed with flow from either direction. Sizes larger than 1" are one way flow and must be installed with flow as indicated by arrow and in/out lettering cast on valve body.

Mueller MARK II ORISEAL Curb Valve
Inlet: Copper flare nut
Outlet: F.I.P. thread
Quarter turn check with drain

H-15184N

3/4"	1"	1-1/2"‡	2"‡

Mueller MARK II ORISEAL Curb Valve
Inlet: Copper flare nut
Outlet: F.I.P. thread
Quarter turn check and Minneapolis top thread

H-15124N

3/4"	1"‡

NOTE: Sizes shown above represent nominal size of valve.
‡Requires minimum ordering quantity. Contact MUELLER Customer Service Center for minimum ordering requirements and availability.

Mueller Service Tees are manufactured and tested in accordance with ANSI/AWWA C800. Components in contact with potable water will also comply with latest requirements of the Federal Safe Drinking Water Act.

CURB BOXES - EXTENSION TYPE WITH ARCH PATTERN BASE

Rev. 9-09 Shaded area indicates changes

Extension type curb box with arch pattern base-for 1/2" through 2" curb valves

The arched base rests on top of the valve and extends down around the valve head to help exclude dirt and debris. The box is cast iron and is furnished with a cast iron lid and brass pentagon plug (the H-10314 is furnished with a one piece lid that requires a spanner wrench to remove – wrench ordered separately). The upper part of the box is spring loaded and telescopes into the base to allow for grade adjustment within the range given in the dimension charts. Stationery rods, shut-off rods, and pentagon keys are optional and are ordered separately.

Box Selection

Curb valve and size	Box	
	Catalog number	Inside diameter
300™ Ball		
3/4"	H-10306	1-1/4"
	H-10308	1-1/2"
	H-10314	1"
	H-10334	1"
1"	H-10306	1-1/4"
	H-10308	1-1/2"
	H-10314	1"
	H-10334	1"
1-1/2"	H-10310	2"
Mark II®		
3/4"	H-10306	1-1/4"
	H-10308	1-1/2"
1"	H-10306	1-1/4"
	H-10308	1-1/2"
1-1/4"	H-10310	2"
	H-10314**	1"
	H-10334**	1"
1-1/2"	H-10310	2"
2"	H-10310	2"
ORISEAL III®		
3/4"	H-10306	1-1/4"
	H-10308	1-1/2"
	H-10314**	1"
	H-10334**	1"
1"	H-10306	1-1/4"
	H-10308	1-1/2"
	H-10314**	1"
	H-10334**	1"
Inverted key curb valve		
3/4"	H-10306	1-1/4"
	H-10308	1-1/2"
	H-10314**	1"
	H-10334**	1"
1"	H-10306	1-1/4"
	H-10308	1-1/2"
	H-10314**	1"
	H-10334**	1"

***The H-10314 and H-10334 boxes are the same except the H-10314 is furnished with a one piece lid, the H10334 has a combination lid and pentagon plug.*

TO ORDER BOXES SPECIFY EXTENDED LENGTH, SIZE OF MINNEAPOLIS THREAD AND CATALOG NUMBER

Dimensions and Optional Stationary Rod

H-10306 and H-10308 curb boxes

Curb box catalog number	Box length extended		Box length fully retracted		Weight		Optional stationary rod	
	in.	mm	in.	mm	lbs.	kg	Part number	Length (in.)
H-10306 1-1/4" upper section	24	610	18.00	457.0	12.0	5.4	84774	12-3/4
	30	762	18.00	457.0	14.0	6.4	84346	15
	36	914	24.00	610.0	15.0	6.8	84275	21
	42	1067	30.00	762.0	16.0	7.3	84233	27
	48	1219	36.00	914.0	17.0	7.7	84245	33
	54	1372	42.00	1067.0	18.0	8.2	84247	39
	60	1524	46.00	1219.0	19.0	8.6	84154	45
	66	1676	54.00	1372.0	20.0	9.1	84261	51
	72	1829	60.00	1524.0	22.0	10.0	84341	57
	78	1981	66.00	1676.0	23.0	10.4	84297	63
	84	2134	72.00	1829.0	24.0	10.9	84152	69
	90	2286	78.00	1981.0	25.0	11.3	88703	75
	96	2438	84.00	2143.0	26.0	11.8	84274	81
H-10308 1-1/2" upper section	24	610	20.44	519.2	13.0	5.9	-	14
	30	762	20.44	519.2	15.0	6.8	84742	16
	36	914	24.00	610.0	16.0	7.3	84256	18
	42	1067	30.00	762.0	17.0	7.7	84326	24
	48	1219	36.00	914.0	18.0	8.2	84305	30
	54	1372	42.00	1067.0	20.0	9.1	84338	36
	60	1524	46.00	1219.0	21.0	9.5	84353	42
	66	1676	54.00	1372.0	22.0	10.0	88702	48
	72	1829	60.00	1524.0	23.0	10.4	84255	54
	78	1981	66.00	1676.0	25.0	11.3	83299	60
	84	2134	72.00	1829.0	26.0	11.8	80643	66
	90	2286	78.00	1981.0	27.0	12.2	84832	72
	96	2438	84.00	2143.0	28.0	12.7	88139	78

H-10306 and H-10308 curb boxes

Curb box catalog number	Box length extended		Box length fully retracted		Weight		Optional stationary rod	
	in.	mm	in.	mm	lbs.	kg	Part number	Length (in.)
H-10310 2" upper section	24	610	21.44	544.5	21.0	9.5	-	-
	30	762	21.44	544.5	23.0	10.4	84146	15
	36	914	24.00	610.0	25.0	11.3	84162	21
	42	1067	30.00	762.0	27.0	12.2	84147	27
	48	1219	36.00	914.0	28.0	12.7	84176	33
	54	1372	42.00	1067.0	30.0	13.6	84139	39
	60	1524	46.00	1219.0	32.0	14.5	84140	45
	66	1676	54.00	1372.0	34.0	15.4	84128	51
	72	1829	60.00	1524.0	35.0	15.9	84143	57
	78	1981	66.00	1676.0	37.0	16.8	84222	63
	84	2134	72.00	1829.0	39.0	17.7	84169	69
	90	2286	78.00	1981.0	41.0	18.6	-	75
	96	2438	84.00	2143.0	43.0	19.5	-	81
H-10314 and H-10334 1" upper section	24	610	18.00	457.0	9.5	4.3	82875	11.25
	30	762	18.00	457.0	10.0	4.5	82892	16.75
	36	914	24.00	610.0	11.0	5.0	82862	21.0
	42	1067	30.00	762.0	12.0	5.4	82863	27.0
	48	1219	36.00	914.0	14.0	6.4	82864	33.0
	54	1372	42.00	1067.0	15.0	6.8	82865	39.0
	60	1524	46.00	1219.0	16.0	7.3	82866	45.0
	66	1676	54.00	1372.0	17.0	7.7	82867	51.0
	72	1829	60.00	1524.0	18.0	8.2	82868	57.0
	78	1981	66.00	1676.0	19.0	8.6	82869	63.0
	84	2134	72.00	1829.0	20.0	9.1	82870	69.0
	90	2286	78.00	1981.0	21.0	9.5	82871	75.0

Extra lids and plug

Lids are cast iron with an integrally cast brass bushing which allows for easy removal of pentagon plug.

* Stationary rods are supplied with H-10314 and

Lid with Plug

Plug only

One piece lid

Curb Box Catalog number	One piece lid part number	Lid with brass pentagon plug - part number	Lid with brass bushing and cast iron plug	Plug only part number	
				Cast Iron	Brass
H-10306	-	89369	89375	58039	63670
H-10308	-	581642	89980	58116	63683
H-10310	-	681714	89981	59478	63684
H-10314**	89982	-	-	-	-
H-10334**	-	89376	89376	-	36571

H-10334 only. Stationary rods are optional with all other boxes shown on this page and must be ordered separately.

*** The H-10314 and H-10334 boxes are the same except the H-10314 is furnished with a one piece lid, the H-10334 has a combination lid and pentagon plug.*

TO ORDER BOXES SPECIFY EXTENDED LENGTH, SIZE OF MINNEAPOLIS THREAD AND CATALOG NUMBER

Large Arch Pattern Base

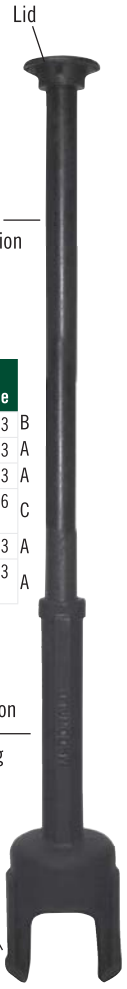
FOR USE WITH AY MCDONALD 1 1/4", 1 1/2" AND 2" BALL CURB STOPS

5603

- 1" I.D. Upper Section
- Includes 5674 stationary rod
- **5601L - Two hole Erie Lid**

5600

- 1 1/4" I.D. Upper Section
- Shut-off rod available
- **5614L Lid - with 1 1/4" brass pentagon plug**



5603
1" Upper with Rod

Part No.	Size	Pallet PCS/WT	Price
4513-112	2 1/2	1/17	$106.85
4513-113	3	1/18	$110.89
4513-114	3 1/2	1/19	$115.36
4513-115	4	1/20	$122.57
4513-116	4 1/2	1/21	$126.77
4513-117	5	1/22	$128.70
4513-118	5 1/2	1/23	$132.85
4513-119	6	1/24	$137.51
4513-120	6 1/2	1/25	$142.53
4513-121	7	1/26	$146.38
4513-122	7 1/2	1/27	$151.41
4513-123	8	1/28	$156.18
4513-203	10	1/33	$195.23

5603LR
1" Upper L/Rod

Part No.	Size	Pallet PCS/WT	Price
4511-172	2 1/2	50/781	$94.32
4510-143	3	50/806	$97.40
4510-145	3 1/2	50/831	$100.49
4510-147	4	50/856	$105.72
4510-149	4 1/2	50/881	$108.79
4510-151	5	50/906	$109.51
4510-153	5 1/2	50/1000	$112.45
4510-155	6	50/1018	$115.61
4510-157	6 1/2	50/981	$118.27
4510-159	7	50/1006	$121.27
4510-161	7 1/2	50/1031	$124.92
4510-163	8	50/1056	$128.40
4513-202	10	50/1217	$160.52

5600
1 1/4" Upper L/Rod

Part No.	Size	Pallet PCS/WT	Price
4516-185	2 1/2	100/1618	$94.24
4516-170	3	100/1710	$97.36
4516-171	3 1/2	100/1790	$100.49
4516-172	4	100/1890	$105.72
4516-168	4 1/2	100/1985	$108.79
4516-173	5	100/2072	$109.51
4516-174	5 1/2	100/2140	$112.45
4516-169	6	100/2200	$115.61
4516-175	6 1/2	100/2335	$118.27
4516-176	7	100/2460	$121.27
4516-177	7 1/2	100/2550	$124.92
4516-178	8	100/2612	$128.40

5614 Lids

	Part No.	Model	Marking	Price	
D	4511-165	5614L	"Water"	$25.73	B
E	4510-441	5614LG	"Gas"	$25.73	A
E	4510-435	5614LPS	"Sewer"	$25.73	A
D	4510-468	5614LTW Tracewire	"Water"	$29.56	C
E	4510-443	5614LSK	"Irrigation"	$25.73	A
E	4510-442	5614LRW	"Reclaimed Water"	$25.73	A

5602

- 1" I.D. Upper Section
- Includes 5674 stationary rod
- **5607L Lid - with 1" brass pentagon plug**

5606

- 2" I.D. Upper Section
- Shut-off rod available
- **5624L Lid - with 2" brass pentagon plug**

5602
1" Upper with Rod

Part No.	Size	Pallet PCS/WT	Price
4510-007	2 1/2	1/18	$106.85
4510-009	3	1/19	$110.89
4510-011	3 1/2	1/20	$115.36
4510-013	4	1/21	$122.57
4510-015	4 1/2	1/22	$126.77
4510-017	5	1/23	$128.70
4510-019	5 1/2	1/24	$132.85
4510-021	6	1/25	$137.51
4510-023	6 1/2	1/26	$142.53
4510-025	7	1/28	$146.38
4510-027	7 1/2	1/28	$151.41
4510-029	8	1/29	$156.18

5602LR
1" Upper L/Rod

Part No.	Size	Pallet PCS/WT	Price
4510-006	2 1/2	50/813	$94.32
4510-008	3	50/850	$97.40
4510-010	3 1/2	50/870	$100.49
4510-012	4	50/910	$105.72
4510-014	4 1/2	50/945	$108.79
4510-016	5	50/988	$109.51
4510-018	5 1/2	50/1030	$112.45
4510-020	6	50/1060	$115.61
4510-022	6 1/2	50/1095	$118.27
4510-024	7	50/1120	$121.27
4510-026	7 1/2	50/1175	$124.92
4510-028	8	50/1193	$128.40

5606
2" Upper L/Rod

Part No.	Size	Pallet PCS/WT	Price
4516-156	2 1/2	50/1010	$128.59
4516-157	3	50/1093	$133.08
4516-158	3 1/2	50/919	$137.46
4516-128	4	50/1254	$141.89
4516-129	4 1/2	50/1300	$145.89
4516-130	5	50/1350	$153.99
4516-131	5 1/2	50/1301	$158.48
4516-132	6	50/1500	$163.23
4516-133	6 1/2	50/1501	$166.94
4516-134	7	50/1602	$178.54
4516-135	7 1/2	25/851	$186.35
4516-136	8	25/901	$190.04
4516-159	10	25/1025	$237.54

5607 Lids

	Part No.	Model	Marking	Price	
D	4511-164	5607L	"Water"	$20.22	C
E	4510-438	5607LG	"Gas"	$20.22	A
E	4510-428	5607LPS	"Sewer"	$20.22	A
E	4511-387	5607LD	"Water"	$21.22	A
D	4510-467	5607LTW Tracewire	"Water"	$24.05	C
E	4510-440	5607LSK	"Irrigation"	$20.22	A
E	4510-439	5607LRW	"Reclaimed Water"	$20.22	A

5624 Lids

	Part No.	Model	Marking	Price	
D	4511-167	5624L	"Water"	$38.39	B
D		5624LG		$34.51	B
D	4511-012	5624LPS	"Sewer"	$34.51	B
D	4511-301	5624LTW Tracewire	"Water"	$42.67	B
D	4511-011	5624LFS	"Fire Sprinkler"	$34.51	B

5601 Lids

	Part No.	Model	Marking	Price	
D	4511-163	5601L	"Water"	$12.45	B
D	4511-388	5601PL	"No Marking"	$13.15	B

NOTES
- Order by model number and maximum extended lengths from 2 1/2' thru 10' (in 6" increments). Example: 5603 8 1/2'
- When rods are furnished with Curb Boxes, they are 18" shorter than maximum extended length of Curb Box.
- All Curb Boxes telescope one foot. Lengths shown are at maximum extension:
  Example: A 5' Curb Box can be used at depths ranging from 4' to 5'.
- **Shut Off Rods and Available Lid Options, see Curb Boxes accessories.**

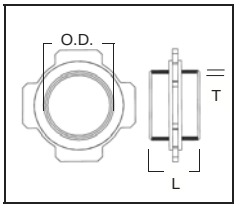
***Chart Character Key**
A - Slot in lid with rope thread
B - No slot in lid with npsm thread
C - Slot in lid with npsm thread
D - USA made
E - North American made

ENGINEERING DATA / CAD DRAWINGS

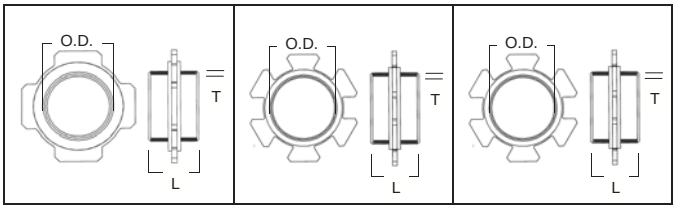
FOSTER ADAPTOR

BOLT-THRU MECHANICAL JOINT RESTRAINT

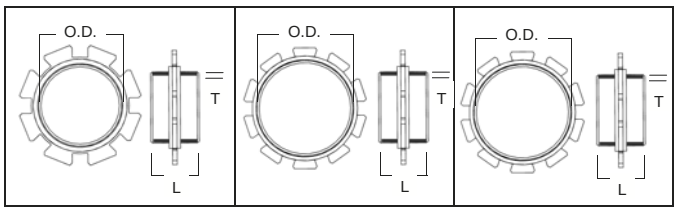
RESTRAIN MJ VALVES AND FITTINGS TO EACH OTHER



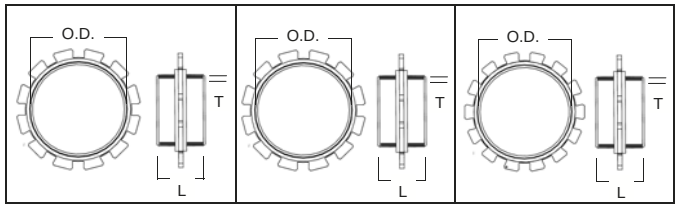
3-INCH



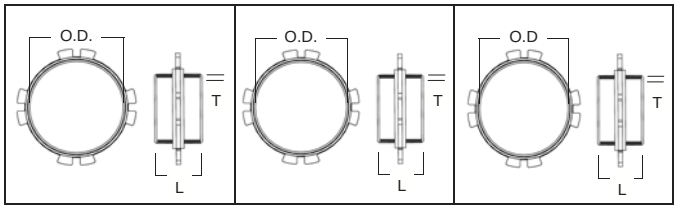
4-INCH 6-INCH 8-INCH



10-INCH 12-INCH 14-INCH



16-INCH 18-INCH 20-INCH



24-INCH 30-INCH 36-INCH

LATEST SIZES ADDED: 3-inch, 30-inch, and 36-inch

SIZE, inches	DIMENSIONS, inches			ADAPTOR Weight	PAK Weight	TOTAL Weight
	O. D.	T	L	lbs.	lbs.	lbs.
3	3.96	.34	4	6	5	11
4	4.80	.35	4	8	8	16
6	6.90	.37	4	16	9	25
8	9.05	.39	4	19	10	29
10	11.10	.40	4	29	13	42
12	13.20	.43	4.5	31	15	46
14	15.30	.48	6.75	55	16	71
16	17.40	.51	6.75	60	20	80
18	19.50	.55	6.75	92	16	108
20	21.60	.58	6.75	101	20	121
24	25.80	.62	6.75	117	28	135
30	32.00	.66	7.75	153	68	221
36	38.30	.75	7.75	220	86	306

Adaptor sizes, dimensions and weights are nominal

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GENERAL SPECIFICATIONS FOR PAVEMENT - CONCRETE WORK

1.00 GENERAL

1.01 WORK INCLUDED: The work in this section includes materials, mixing, proportioning, sampling, testing, placing, and finishing of all reinforced and non-reinforced concrete. Included also are formwork, reinforcing, scaffolding (as required), curing and related items. All of this work as mentioned shall be included in the unit price of the item.

2.00 APPLICABLE STANDARDS: As follows:

2020 MDOT Standard Specifications for Construction
MTM 101-730 Michigan Test Methods, current version

This specification shall govern in conflict between this specification and listed standards.

3.00 MATERIALS:
Materials shall conform to the current MDOT Standard Specifications for Construction, Sections 601 and 701.

3.01 CEMENT: Cement shall be Portland Cement conforming to ASTM C150, Type 1 or Type 1L.

3.02 REGULAR AGGREGATE: Fine, intermediate, and coarse aggregates shall conform to ASTM C33.

3.03 WATER: The water shall be clean and free from injurious amounts of oil, acids, alkalis, organic materials or deleterious substances.

3.04 AIR-ENTRAINING AGENT: Air-entraining agent shall conform to ASTM C260 and be used at a dosage rate within the limits indicated in the MDOT Qualified Products List (QPL), current version.

3.05 WATER-REDUCING, SET-CONTROLLING ADMIXTURE: The water-reducing agent shall conform to ASTM C494, Type A, F, G or MR and be used at a dosage that is within the limits indicated in the MDOT Qualified Products List (QPL), current version.

3.06 PENETRATING SEALANT: Refer to the MDOT Approved Materials Source Guide for acceptable sealant products. Sealant shall be silane based.

3.07 METAL REINFORCEMENT: Metal reinforcing bars shall conform to the requirements of the Specifications for Steel Bars for Concrete Reinforcement.

3.08 EXPANSION JOINT FILLER: Joint fillers shall extend full depth of slab or joints and be of thickness shown on drawings.

3.09 CONTROL JOINT FILLER: Control joints shall be sealed before opening the roadway to traffic. The sealing compound shall meet all material and installation requirements specified in Sections 603 and 914.04 “Hot Poured Joint Sealant” of the MDOT 2020 Standard Specifications for Construction. Install the top of the seal ¼-inch below the surface of the roadway.

4.00 PROPORTIONING OF MATERIALS

4.01 **COMPOSITION**: The concrete shall be composed of Portland Cement, cement substitutes (ground granulated blast furnace slag (GGBFS) or slag cement), fine aggregate, intermediate aggregate, coarse aggregate, water, admixtures, and air-entraining agent as required.

4.02 **PROPORTIONING OF MIXTURES**: Regular concrete shall be proportioned in accordance with 2020 MDOT Standard Specification Section 601 (pavements) and 701 (structures) as applicable.

4.03 **STATEMENT OF PROPORTIONS**: **At least 14 days prior to beginning work, the Contractor shall submit a statement of the proportions proposed for the concrete.** This shall be accompanied by reports and data regarding proportions previously used and strength tests performed on concrete of the same or similar requirements, or by a report in detail from an approved testing laboratory or inspection service showing, for at least three different water contents, the 7-day and 28-day concrete strength obtained when using the materials proposed for the work.

All such reports and tests shall be made at the expense of the Contractor.

4.04 **GROUT**: Proportions of grout, by volume, for filling block cores are 1 part Portland cement, 2.5 parts fine aggregate and 1.5 parts coarse aggregate, maximum size 3/8-inch.

5.00 BATCHING OF MATERIALS AND PLACING

5.01 **READY-MIXED CONCRETE**: Ready-mixed concrete shall be used and shall conform to 4000-HP 6.0-sack mix design with a minimum cementitious content of 564 lb/cy as listed in 2020 MDOT Standard Specification Table 1004-1, ASTM C-94 (alternate No. 2) ACI-301 and ACI-614, and MDOT 2020 Standard Specifications for Construction Sections 602, 603, 803 and 1004 thru 601.03. All exterior concrete shall have ground granulated blast furnace slag (GGBFS or Slag Cement) substitution of at least 20% up to a maximum 25% of the total cement content. Air content shall range between 5.5% and 8%. The mix shall include a mid-range or high-range water reducing agent.

A load ticket shall be provided for each load used on the project. Provide an automated printout of target and actual batch weights with each delivery ticket. If target and actual batch weight information is computer generated on a separate document, include the serial number of the corresponding delivery ticket, or other means of cross reference. Attach the automated printout of target and actual batch weights to the corresponding delivery ticket. Collect tickets accompanying loads of concrete and provide them to the inspector. The ticket shall indicate the mixture composition, batch time, loading time. Water shall not be added to any load of concrete at the job site without the approval of a representative of the City of Royal Oak. Any water added shall be written by the Contractor or concrete supplier on the load ticket.

5.02 **COLD WEATHER BATCHING**: Refer to 2020 MDOT Standard Specification Section 601.03.

5.03 **LATE SEASON PLACEMENT:** For concrete placed after September 30, a penetrating silane sealant shall be applied to the concrete within 30 to 40 days after placement. This work shall not be paid for separately and shall be included in the unit price for concrete.

5.04 **RETEMPERING**: Concrete shall be mixed in such quantities as are required for immediate use and shall be placed while fresh and before loss of slump occurs. Retempering (adding water to restore slump lost during excessive mixing or during too long an elapse of time since initial mixing) will NOT be permitted.

5.05 **CONVEYING**: Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of materials. Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete out the delivery end without separation of the materials.

5.06 **PLACING OF CONCRETE**: Placing of concrete shall be in accordance with 2020 MDOT Standard Specification Section 602. Concrete shall be consolidated by means of mechanical vibrating equipment. The number of vibrators used shall be sufficient to consolidate the concrete properly. At least one standby vibrator shall be on hand at all times that concrete is being placed. The concrete shall not drop freely more than 3 feet.

5.07 **PLACING OF GROUT**: Placing of grout in block cores shall be done in a continuous pour, in lifts not exceeding 4 feet. It shall be consolidated by puddling, rodding or vibrating during placement and reconsolidated after excess moisture has been absorbed, but before plasticity is lost.

Grout shall be placed by pumping, poured from buckets equipped with spouts or an approved alternate method.

5.08 **NEW CONCRETE ON SET CONCRETE**: Before depositing new concrete on or against concrete which has set, the surface of the set concrete shall be roughened as required, and cleaned of all foreign matter and laitance. It shall be saturated with water and with a coat of mortar grout applied, and the concrete placed while the grout is still soft.

5.09 **TEST SPECIMENS**: The Engineer will make arrangements with an independent laboratory for performance of quality control tests. Test cylinders shall be protected by the Contractor as required in the Materials Testing specification.

6.00 FORM WORK

6.01 **INSTALLATION**: Forms shall conform with the working drawings to the shape, line and dimensions of members and shall be substantially free from surface defects, full height, sufficiently tight to prevent leakage. They shall be properly braced and tied to maintain position and shape. Forms shall be in accordance with ACI-347.

6.02 **REMOVAL**: Remove forms in a manner and at such time to ensure complete safety of the concrete. In no case shall supporting forms or shoring be removed until sufficient strength has been obtained to support weight and load. All forms are required to be removed prior backfilling and restoration.

7.00 EXPOSED FINISH

7.01 **HORIZONTAL SURFACES (SLABS, WALKS, ETC.)**: Concrete for roadways and sidewalk shall be struck off and floated to a smooth uniform surface with a metal float. All edges shall be rounded to a radius of 1/3 inch with an approved finishing tool. The surface shall then be brushed to slightly roughen the surface.

8.00 METAL REINFORCEMENT

8.01 **CLEANING AND BENDING**: Reinforcement, at the time concrete is placed, shall be free from rust scale, hardened concrete, or other coatings that will destroy or reduce the bond. Bars shall be bent cold.

8.02 **PLACING REINFORCEMENT**: Metal reinforcement shall be accurately placed in accordance with the plans and shall be adequately secured in position by concrete or metal chairs and spacers.

8.03 **SPLICES**: Necessary splices not shown on drawings shall be lapped in accordance with the ACI-318 Specifications.

9.00 CONSTRUCTION JOINTS

9.01 **USE AND LOCATION**: The use and location of monolithic construction joints shall be subject to prior approval of the Engineer. Where a joint is to be made, the surface of the concrete shall be roughened, as required, thoroughly cleaned, and all laitance removed. In addition, vertical joints shall be thoroughly wetted and immediately applied with a coat of neat cement grout before the placing of new concrete.

10.00 STANDARDS FOR CONCRETE PAVEMENT REMOVAL AND REPLACEMENT

10.01 **SAW CUTS**: As follows:

A. All saw cuts shall be parallel to existing joints or back of curbs. All transverse saw cuts and joints shall be perpendicular to back of curbs and existing longitudinal joints. All longitudinal saw cuts and joints shall be parallel to back of curbs or existing longitudinal joints.

B. No saw cuts shall be made closer than 5 feet to an existing joint and any pavement removal shall be to a width of no less than 5 feet.

C. The preceding standards shall apply to all saw cuts except for the following three conditions:

1. When replacing a spalled transverse joint, saw cuts may be done 2 feet from each side of the transverse joint.
2. When replacing integral curb, saw cuts shall be done 2 feet in from the back of curb.
3. When replacing spalling at the intersection of a transverse and longitudinal joint, saw cuts may be done at a 45 degree angle to the existing joints provided that the saw cuts begin and end no more than 5 feet and no less than 2 feet from the intersection of the transverse and longitudinal joint.

D. All saw cuts for new pavement shall be 1/4 of the slab thickness for pavements less than or equal to 7-inch thickness, and 1/3 the slab thickness for pavements greater than 7-inch thickness.

E. Start sawing operations after the new concrete pavement hardens but before random cracks develop in the concrete pavement. Immediately stop sawing operations on new pavement if sawing causes raveling, spalling, or damage to the concrete surface. Continue to monitor the concrete hardness before resuming sawing operation

F. All saw cuts for pavement removal shall be full depth of the pavement thickness.

G. All sawcutting shall be performed with water to prevent airborne dust. Slurry produced from saw cutting within pedestrian areas shall be washed away immediately to prevent hazardous conditions.

10.02 DIAMOND GRINDING: Concrete diamond grinding shall only be performed at the direction of the Engineer. All work shall conform to the 2020 MDOT Standard Specifications for Construction, Section 603.

10.03 COLD-MILLING CONCRETE PAVEMENT Use cold-milling machine(s) equipped with positive depth control adjustments and a positive means for controlling the cross slope. Cold-milling equipment must be capable of removing the chips from the pavement and preventing dust from escaping into the air.
Cold-mill the existing concrete pavement to the depth and cross section indicated on the log or plans, and as directed by the Engineer. Collect and dispose of the excess material resulting from the operations. Provide a final surface texture that is reasonably smooth and free of gouges, holes or large depressions. Prevent damage to the adjacent concrete. Repair all damage to adjacent surfaces as directed by the Engineer. All costs associated with this corrective work will be borne by the Contractor. This work includes removing, loading, hauling, and disposal of the material.

10.04 CONCRETE
Concrete pavement shall conform to the following standards:

Aggregate Base Course ..... MDOT 21AA
Concrete pavement, sidewalk, curb/gutter ..... Air Entrained Concrete (4000 p.s.i.) or as called for in the Contract

Concrete thicknesses shall be as follows:

Local roads:	7-inch minimum
Major roads:	9-inch minimum
Sidewalk:	4-inch
Handicapped sidewalk ramps:	6-inch minimum, 8-inch streetscape
Sidewalk across drives and alleys:	6-inch (residential) 8-inch (commercial & streetscape)
Driveway approaches:	6-inch (residential) 8-inch (commercial & streetscape)

10.05 FORMS: All forms shall be straight and secured to ensure rigidity so that the finished pavement does not exceed the following limits when tested with a 15 foot straight edge.

A. Vertical Limit - the variation of the surface from the testing edge of the straight edge shall at no point exceed 3/16 inches.

B. Horizontal Limit - The variation of a joint or back of curb from the testing edge of the straight edge shall at no point exceed 3/4 inches.

10.06 BULKHEAD JOINTS: As follows:

A. Bulkhead joints between new and existing pavement shall be made with hook bolts whenever possible. Hook bolts shall be 5/8 inches in diameter and anchored to the existing pavement at 3 feet on center maximum for transverse joints and 4 feet on center maximum for longitudinal joints. Hook bolts may be omitted if a shear key is present in the existing slab, only if approved by the Engineer.

B. When an existing longitudinal crack intersects a transverse bulkhead joint and longitudinal joint is not provided in the new pour, a 2 foot long and 1/2 inch thick expansion shall be installed within 5 feet of the crack. The expansion paper shall be recessed 1 inch below pavement surface. The preceding standard shall also apply when an existing transverse crack intersects a longitudinal bulkhead joint.

C. When a longitudinal and transverse bulkhead joint intersect and a transverse or longitudinal joint is not present in the existing pavement, a 2 foot long and 1/2 inch thick expansion paper shall be installed at the intersection of the bulkhead joints and recessed 1 inch below pavement surface.

   If a transverse joint is not present in the existing pavement, a transverse joint shall be saw cut in the pavement so that it is continuous between back of curbs.

D. In lieu of hook bolts, epoxy coated deformed dowel bars or lane ties shall be used for full-depth pavement repairs. Lane ties shall be installed in-place using a grouting material as directed and approved by the Engineer. Lane ties shall be straight deformed epoxy coated bars grouted into the existing pavement with a grout selected from the prequalified materials listed in the MDOT Material Source Guide under adhesive systems for grouting dowel bars and tie bars for full-depth pavement repairs.

E. When an existing transverse crack intersects a longitudinal joint and a transverse joint is not provided at the existing crack, lane ties shall be omitted between the crack and the next closest established transverse joint. When a transverse joint is provided on a new concrete pavement between the existing transverse joint and the existing transverse crack, lane ties shall be omitted between the existing and the new transverse joints. Lane tie omissions shall conform to the details shown on MDOT standard plan for concrete pavement repair, R-44-F.

10.07 LONGITUDINAL JOINTS:

A. Longitudinal joints within new pavement shall be made with 2 foot long epoxy-coated #5 bars at 4 feet on center maximum.

B. When replacing 1/2 width or more of roadway, intermediate longitudinal joints shall be provided between centerline and back of curb if any of the following conditions exist at both ends of the new pour:

    1. An expansion joint.
    2. An existing longitudinal joint or crack that is no less than 5 feet from centerline of back of curb.

C. When replacing roadway, it is desirable to locate any new longitudinal saw cuts or joints at the quarter widths and at the centerline of the roadway, unless otherwise directed by the Engineer.

D. Refer to the specification for Joint and Crack Sealing.

10.08 TRANSVERSE JOINTS: As follows:

A. Transverse joint spacing shall be a maximum of 1.5 times the longitudinal joint spacing, or as directed by the Engineer. All transverse joints shall be continuous between back of curbs.

B. New pavement shall be constructed with two #4 epoxy-coated bars located at 4 inches and 20 inches in from back of curb, which shall be continuous through transverse contraction joints.

C. Transverse expansion joints shall be made using 1 inch fiber board recessed 1 inch below pavement surface. The expansion joints must terminate at a free edge and shall be located as follows:

    1. At all radius returns.
    2. At intervals not exceeding 300 feet
    3. Away from low points whenever possible.

D. When replacing roadway, it is desirable to locate any new transverse saw cuts or joints at either the mid-point or third-point of existing slabs.

E. The transverse relief joints of the new concrete pavement shall be extended all the way through the adjacent existing concrete pavement when directed by the engineer.

F. Refer to the specification for Joint and Crack Sealing.

10.09 CURBING: As follows:

A. When installing a curb drop and a sidewalk exists directly adjacent to and paralleling the back of curb, the back of curb shall drop longitudinally from full height to the drop curb section over a distance that provides less than 1-inch of drop per foot of curb to comply with ADA requirements.

B. Concrete curb and gutter shall be at least 2-foot wide, reinforced with two continuous epoxy-coated #4 bars, and shall be jointed at no greater than 10 feet intervals.

C. Straight face curbing shall only be installed when approved by the Engineer and shall only be a minimum of 18 inches in height and reinforced with one continuous #4 epoxy-coated bar located at mid-depth and the curbing shall be jointed at no greater than 10 feet intervals.

D. Handicapped ramps and driveway approaches **shall not** be poured integral with any curbing. A full-depth, ½-inch fiber joint shall be installed at the back of curb.

E. Any new curbing installed at a crosswalk shall be poured to accommodate handicap ramps per ADA requirements. All handicap ramps shall have a ramp slope that provides less than 1 inch of drop per foot and shall conform to the details shown on page PD-2 through PD-9.

10.10 DRIVEWAY APPROACHES: Driveway approaches shall be replaced according to the plan on detail page PD-1. A full-depth, ½-inch expansion paper joint shall be placed and sealed at the base of the drive approach or ¼-inch contraction paper (dummy paper). Also install ½-inch fiber joint at the top of the approach along the sidewalk.

10.11 CURING: After finishing operations have been completed and immediately after the free water has left the surface of the slab, the slab shall be completely coated and sealed with a uniform layer of white membrane curing compound. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations. Concrete pavement base which will receive a bituminous cap shall receive a transparent curing compound.

Refer to MDOT 2020 Standard Specifications for Construction, Section 903.06 for additional requirements.

10.12 CONCRETE SURFACE FINISH: All concrete surfaces shall have a broomed or burlapped finish and shall be free of spalling, scaling, popping, cracking or imperfections over the length of the warranty period.

10.13 PLACEMENT: All concrete road pavement up to 31 feet wide, both 7 and 9 inches thick installed in public right of way shall be placed with a self-propelled paving profiler (Pav-Saver or equal) running on steel full height forms. Alley paving may be placed using a machine capable of installing the full width of alley pavement with one pass. Other paving means shall be approved by the City Engineer.

Upon placement of the concrete mixture on an approved wetted base, all edges shall be vibrated with a mechanical vibrator and the use of a roller bug or equivalent is prohibited. Once forms are removed, all voids (honeycombs) in the back of the curb **shall** be filled with ASTM C928 Type R-2 mortar.

GENERAL SPECIFICATIONS FOR PAVEMENT-SIDEWALK AND HANDICAP RAMPS

1.00 SIDEWALK

1.01 CONCRETE SIDEWALKS: Ready-mixed concrete for sidewalks shall conform to Article 5.01 in "Concrete Work."

All sidewalks and driveways are to be replaced within 5 days of removal. This item includes all **earth excavation, grading, or fill required** to set proper grades for replacement sidewalk or the installation of new sidewalk where none previously existed, and all clean up and restoration including topsoil, irrigation repairs, and clean up as required within 10 days of removing the sidewalk following the new sidewalk installation.

Payment for this item will not be made until all items of work are complete.

New concrete sidewalks shall be 5 feet wide, shall have 5-foot joint spacing and shall be 4 inches thick minimum, unless otherwise directed by the Engineer.

New concrete sidewalks falling within the influence of a driveway shall be 6 inches to 8 inches thick per Article 10.04 in "Concrete Work." The **entire flag** shall have the same uniform thickness. The joint between the 4-inch concrete and both sides of the thickened walk shall be separated with full-depth, ½-inch fiber expansion paper. See paving details for more information. At handicap ramps, at least the first 5 feet of ramp placed at the back of the curbing shall be 6 inches thick.

Tool joints shall extend to 1/4 of the slab thickness for sidewalk less than or equal to 7-inch thickness, and 1/3 the slab thickness for pavements greater than 7-inch thickness. Where the tool cannot extend deep enough, provide sawcut joints.

Where sidewalk abuts the back of curb, install either ¼-inch contraction paper (dummy paper) or full-depth, ½-inch fiber expansion paper with joint sealant. In the downtown areas, Sikaflex-2cNS or Sikaflex-2cLS with limestone gray tint shall be used to seal expansion paper joints.

1.02 STAMPED COLORED CONCRETE PAVEMENT: This item of work consists of constructing a decorative (colored and stamped) concrete pavement or sidewalk at the locations specified in the plans. Complete this work according to the details provided in the plans, Standard Plan R-44 series, and with Sections 601,602 and 603 of the MDOT 2020 Standard Specifications for Construction.

Refer to "Concrete Work" Article 5.01 Ready-Mixed Concrete for mix requirements. The concrete mixture shall also conform to requirements of the color admixture manufacturer.

The Contractor shall provide documentation of experience placing and finishing colored, stamped concrete as specified herein. The Contractor shall have Michigan Concrete Association (MCA) Decorative Concrete Certification, or proven equivalent manufacturer training and certification for placing decorative concrete.

Use a single manufacturer's complete system for products and / or materials.

Submit a plan showing types and locations of joints and sequence of construction. Submit a report detailing the concrete mix designs to be used including manufacturers and / or suppliers of mixture components. Submit technical data sheet for a single manufacturer's complete system for products and / or materials including admixtures, colorants, curing compounds, decorative concrete sealer, dry-shake finish materials, imprinting tools and others requested by the Engineer.

Use a complete pigment system including integral colorants, dry shake colorants, and / or release hardeners from one of the following manufactures or other sources approved by the Engineer. Submit ASTM C979 test data to Engineer for all non-approved manufacturers.

Brickform.....217-522-3112
Decorative Concrete Resources.....866-792-9000
Increte Systems 800-752-4626
L.M. Scofield Co.....586-292-1492
Prism Corporation 651-488-4250
Proline Concrete Tools.....800-795-4750
Vexcon Chemicals 888-839-2661

A. Concrete Integral Color: Pre-weighed and dry-packaged high-grade coloring pigment in either powder or granular form. Ensure materials comply with ASTM C979 standards for integrally colored concrete. Use color as indicated:

Stamped Brick Streetscape: Royal Oak Mauve Red 22.56 lb/yd

Alley Pavement: Coal Light and Coal Deep by Prism

B. Release Agent: Dry-shake powder to facilitate release of imprinting tools as manufactured by Brickform, Prism Corporation, or approved equal. Color as indicated:

Brickform Dark Gray

C. Curing Compound: Use transparent curing compound meeting subsection 903.05B of the 2020 MDOT Standard Specifications for Construction (ASTM C309, Type 1 or 1-D). Standard curing compounds cannot be used on colored or decorative concrete. See following section "Surface Sealer" for approved products.

D. Surface Sealer: Use a "crystal clear" Class A solvent acrylic decorative sealer in low-sheen, anti-slip finish from approved list below, or other as approved by the system manufacturer and the Engineer.

1. Brickform - Safety-Seal MS-5
2. Vexcon Chemicals
    a. Certivex AC 1315 solvent vase sealer (with curing compounds)
    b. Certivex Gloss Sealer FT solvent base sealer (without curing compounds)
    c. Certivex Grip - anti-slip sealer additive

E. Stamp: To impart desired texture, use high-quality resilient mats reproduced from casting of natural materials and providing uniform control of joint depth. Use tools capable of producing the pattern(s) shown on the plans and / or as required by the Engineer. Use imprinting tool(s) from approved manufacturer and pattern list below,

or present a substitute mat design, manufacturer, or pattern to the Engineer for approval:

1. Molds:

    a. Brickform – Running Bond New Brick Stamp (no texture, v joints, to be placed perpendicular to the curb) or Engineer approved equal to be used on sidewalk streetscapes.

    b. Ashler Slate – Running Bond New Asher Slate Stamp (no texture, v joints, to be placed perpendicular to the curb) or Engineer approved equal to be used on alley pavements.

    Samples of the paver stamps shall be furnished to the Engineer for approval. Paver stamp dimensions shall not vary more than 1/8 of an inch from approved samples. The stamping equipment and materials shall be from a single manufacturer throughout the entire project.

2. Prior to installation of colored concrete and / or stamped concrete paving work, construct sample panels in place to verify color and texture selections and processes for qualities of appearance, materials, and construction. Build mock-ups to comply with the follow requirements.

3. Size - Cast a minimum 8 foot by 8 foot mock-up to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.

4. Acceptance - If Engineer determines that mock-up does not meet requirements, demolish and remove it from the site, and cast another until the mock-up is accepted.

5. Use - Keep accepted mockup undisturbed during construction as a standard for comparison to completed paving. Undamaged mock-up may be incorporated into the work or demolished and removed from the site when directed by the Engineer.

F. Preparation – as follows:

1. Carefully lay out the locations of forms and joints, taking into consideration the orientation of the pattern as shown on the Plans, intended aesthetics, and construction sequence.

2. Color Release - Apply powder release per manufacturer guidelines at the minimum rate required to cover the previously colored surface. "Liquid Antique" agent can be used as a substitute for the dry release. If clear liquid release is to be used, apply per manufacturer guidelines. Colored powder release can be mixed with clear liquid and sprayed on the surface only after the imprinting has been completed, to create an accent coloring.

3. Imprint Pattern - Comply with tool manufacturer’s standard and MCA practices. Lay out to proper alignment and imprint constant depth while concrete is plastic. Do not allow the surface to crust over or harden before stamping. Hand-tool in the areas where imprinting tools are not practical.

4. Removal of Excess Release - Wash off excess release agent with normal water pressure prior to joints being cut. Remove a minimum of 80 percent of the release. Temperature conditions will dictate the timing of release removal. Dispose of any excess release agent in compliance with local regulations.

5. Acid washing of decorative surface may be required to achieve the desired finish, as directed by the Engineer. A minimum of 36 hours after placement, apply a solution of 1 part muriatic acid to 30 parts potable water to the surface of the pavement and lightly scrub with a straw broom. Wash the surface until proper color has been achieved and then flush thoroughly.
6. Sealing Decorative Surface - Seal the surface with approved sealer according to manufacturer's recommendation. Refer to previous section of this specification for approved products and manufacturer technical data sheets for proper installation procedures, including moisture content restriction at time of application.

Stamped Concrete Sidewalk includes coloring, mixing, hauling, placement, strike off, finishing, texturing, stamping, curing, and all jointing shown in the plans.

All stamped concrete areas installed shall have consistent coloring and be free of cracks and breakage.

2.00 HANDICAP RAMPS

2.01 **SIDEWALK HANDICAP RAMPS**: The Contractor shall comply with the requirements of the American with Disabilities Act of 1990.

Handicap ramps shall be 6 inches thick from back of curb to 5 feet from back of curb, unless otherwise directed by the Engineer. Full-depth, ½-inch expansion paper shall be placed at the back of curb at all ramp installations. Refer to section 5.01 in "Concrete Work" for concrete mix requirements. Refer to handicap ramp details on page PD-2 through PD-9.

Sidewalk slopes and grades shall meet all current requirements of the Americans with Disabilities Act Access Guidelines (ADAAG) and MDOT handicap ramp detail R-28.

Sidewalk abutting back of curb cannot be poured within twelve (12) hours of curb installations, unless approved by the Engineer.

2.02 **DETECTABLE WARNING SURFACE**: The Contractor shall furnish and install a handicap detectable warning dome pattern on all handicap ramps in accordance with the current MDOT detail R-28 (see detail sheets PD-3 thru PD-9).

The 5 feet wide by 2 feet deep detectable warning surface shall be installed at all curb openings (drop curbs) installed for pedestrian crossings. Wet mold stamped concrete handicap detectable warning dome patterns are not acceptable and will not be allowed.

The detectable warning surface shall be centered on the crosswalk at the drop curb, but in no case shall the width of the surface installed be less than 5 feet.

The detectable warning surface shall contrast visually with adjacent walking surfaces, dark-on-light.

The surface materials shall be cast-in place and installed so that the edge nearest the back of curb line is at the back of curb line or as directed by the Engineer.

The detectable warning material shall be ADA Solutions ™- Clay Red (Federal Color Code 22144), Armor-tile ™- Brick Red (Federal Color Code 22144) or approved equal.

The Contractor shall provide written certification to the Engineer that the detectable warning surface complies with all requirements of the Americans with Disabilities Act Access Guidelines (ADAAG).

GENERAL SPECIFICATIONS PAVEMENT- FOR ASPHALT STREET RESURFACING

1.00 **WORK INCLUDED**: The work under the Contract consists of but is not limited to removing and replacing concrete pavement and curbing; reconstructing, adjusting and building drainage structures; grinding asphalt and concrete surfaces; and resurfacing with hot mix asphalt (HMA).

The Contractor shall provide all labor, equipment and materials as specified in these specifications and shown on the plans to complete all aspects of the Contract.

The work covered shall meet the requirements of the 2020 MDOT Standard Specifications for Construction sections 501, 902 and 904.

Contractors may obtain water for milling and cleaning operations from City hydrants at locations approved by the City. However, there **shall** be an air gap equal to or greater than the fill line diameter in the fill line hose / piping prior to water entering the water storage tank. A hydrant wrench shall be used when using a hydrant, approved for use by the Contractor, meeting backflow prevention requirements.

1.01 **MILLING ASPHALT PAVEMENT**: This work consists of removing existing asphalt pavement with a roto-mill pavement profiler machine. This item shall include milling asphalt pavement over gravel, asphalt or concrete up to one inch (1") into underlying concrete pavement. This work will be measured and paid by area in square yards at the contract unit price shown on the Form of Proposal. All chipping around utility castings and areas missed by the grinding machine shall be included with this work item. When milling across intersections and the lip from the milled surface to the existing surface exceeds 1-1/2 inches, this lip shall be ramped. This work shall be included within the item. Measurements of grinding will be done the same day work is completed and agreed to by all parties in writing. Butt joints and clean up are included in this item. Clean up shall begin the same day as milling, refer to detail on page PD-16.

1.02 **MILLING CONCRETE PAVEMENT**: Refer to the specifications for Concrete. Milling of asphalt pavement where milling extends into concrete under the existing asphalt overlay exceeding one inch shall be paid as concrete milling only.

Concrete streets must be thoroughly cleaned and may require spraying with tack / prime coat to control dust once milled. This operation is included as part of this item.

1.03 **MILLING CONCRETE OR ASPHALT PAVEMENT, 18 to 24-INCH WIDE**: This item is intended to be used to mill channel through high areas along curb lines on existing pavement to correct existing drainage problems. The normal width milled would be 18 to 24 inches and maximum 2 inches depth as directed by the Engineer, refer to detail on page PD-16.

Payment shall be by the square yard. Clean up shall be done the same day as the milling.

General Construction Practices as follows:

A. Weather Limitations - No placement will be allowed on wet base; surface to be paved must be dry.

B. Mixture Temperature Limits - The HMA shall be heated sufficiently, but not in excess of 360°F, such that there will be separation of the asphalt from the

aggregates during transportation. The mixture shall be placed at a temperature not less than 250°F.

C. Transportation of Mixtures - The time interval between placing the mixture in the hauling unit and emptying into the spreader shall not exceed two hours.

D. Compaction – After the asphalt mixture has been spread, struck off, and surface irregularities adjusted, the mixture shall be thoroughly and uniformly compacted by rolling. The asphalt mixture shall be rolled in a longitudinal direction, commencing at the outside edge and progressing towards the center, except that on super-elevated curves, the rolling shall commence of the low side and progress to the high side. Rolling shall be accomplished with a steel-sheet roller and shall be conducted in such a manner that shoving or distortion will not develop beneath the roller. The amount of rolling shall be confined to only that necessary for consolidating the asphalt mixture and bonding it to the underlying surface. Excessive rolling shall be avoided. The completed asphalt mixture shall be protected from all traffic until it has cooled sufficiently to resist abrasion.

E. Placement of Joints, Edge Trimming, and Cleanup - Placement of the asphalt mixture shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer. Transverse joints shall be formed by cutting back of the previous run to expose the full depth of the course. When directed by the Engineer, a brush coat of asphalt material shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material. The exposed edges of the completed mat shall be cut off true to the required lines.

   Material trimmed from the edges of any other discarded asphalt mixture shall be removed from the roadway and disposed of by the Contractor at a site meeting the approval of the Engineer. Intersections are to be paved when the paver reaches that point to eliminate cold joints.

F. Method of Measurement - The asphalt mixtures will be measured by weight in tons.

G. Basis of Payment - The completed work as measured will be paid for at the Contract Unit Price.

1.04 **MDOT HOT MIX ASPHALT 3C AND 4C**: Only use when directed by Engineer and in compliance with MDOT Frequently Used Special Provision (FUSP) 20SP-501G-01 “Marshall Hot Mix Asphalt Mixture”.

1.05 **MDOT SUPERPAVE HMA**

Superpave HMA shall be used as directed by the Engineer and shall be in accordance with the MDOT 2020 Standard Specifications for Construction Section 501, 902 and 904. The Engineer shall select the mixture type in accordance with the current MDOT Hot Mix Asphalt Selection Guidelines.

Develop and submit an HMA mix design for approval by the Engineer at least one week in advance of paving. Mix designs shall meet the requirements of MDOT tables 501-1, 501-2 and 501-3.

For mix design purposes, top and leveling courses are the mix layers within 4 inches of the surface. The base course consists of the layers below 4 inches from the surface. For

mix layers within the 4 inch threshold, if less than 25 percent of the mix layer is within 4 inches of the surface, the mix layer is a base course.

Recycled Asphalt Pavement (RAP) may be substituted for a portion of the new material required to produce HMA mixture. RAP may be added as a percentage by weight for Tier 1 or Tier 2 work.

A. Tier 1 (0% to 17% RAP binder by weight of the total binder in the mixture). No binder grade adjustment is made to compensate for the stiffness of the asphalt binder in RAP.

B. Tier 2 (18% to 27% RAP binder by weight of the total binder in the mixture). For all mixtures no binder grade change will occur in Tier 2 for all shoulder and temporary road mixtures. Ensure the required asphalt binder grade is at least one grade lower for the low temperature than the design binder grade required for the specified project mixture type. Supply the blending chart and the RAP test data used in determining the binder selection according to AASHTO M323.

1.06 **BOND COAT:** Uniformly apply the bond coat and provide complete coverage to a clean, dry, surface with a pressure distributor. Select a bond coat product designed for low tracking by equipment travelling offsite. Any tracking cleanup shall be the responsibility of the Contractor.

Obtain the approval of the Engineer for the application rate after work begins. Application rate shall be within a range of 0.05 to 0.15 gallons/sy. Apply the bond coat ahead of the paving operation to allow the bond coat to cure before placing HMA. Do not leave pools of bond coat on the surface and do not spray the bond coat on adjacent pavement surfaces. Apply the bond coat to each HMA layer and to the vertical edge of the adjacent pavement before placing subsequent layers.

1.07 **1-1/2 INCH MINIMUM ASPHALT MATERIAL NO. 36A**: The asphalt material shall meet the requirements and be placed in accordance with 2020 MDOT Standard Specifications, Section 501. This item includes 0.1 gal/sy of SS-1h bond coat or MC-70 prime coat.

1.08 **ASPHALT PATCHING**: This item shall consist of removal and replacement of existing asphalt pavement to solid base material or of up to 6 inches in base material in two (2) lifts and placement of 8 inches of 21AA Crushed Limestone or approved equal base in place, compacted to proper sub-grade. Placement and compaction of asphalt material to finished grade shall be as directed by the Engineer. Perimeter edges of patch areas shall be saw cut unless otherwise directed by the Engineer. The saw cutting is incidental to this item. Payment for this item shall be in square yards as measured the same day as installation. The asphalt material shall be as specified in section 1.04 or approved equal and paid at the as bid contract unit price. The roller used on this item shall be 5-10 ton minimum. This item includes hauling away and disposing of removed asphalt and concrete base material at a recognized landfill.

1.09 **MODIFIED MDOT DETAIL 7 JOINT REPAIRS**: This item shall meet the requirements of the modified MDOT Repair Detail 7 as shown on page PD-15. The asphalt material shall meet the mixture requirements for leveling as specified in section 1.04. Asphalt

mixtures shall be top rolled with a minimum 5-10 ton roller. Use of peanut rollers is unacceptable on this item.

1.10 **MODIFIED MDOT DETAIL 8 JOINT REPAIRS**: This item shall meet the requirements of the modified MDOT Repair Detail 8 as shown on page PD-15. Refer to section 1.04 for asphalt mixture requirements and Section 1.08 for roller requirements.

Where exceptionally large areas are encountered, the Engineer may require removal of the deteriorated section and replacement with concrete pavement. Payment for this item of work shall be by lineal foot.

1.11 **TRANSPORTATION OF HMA:** Weigh each load of HMA, accepted by the Department, to the nearest 20 pounds on an approved scale with an automatic printout system. Provide a ticket to the engineer with each load. Apply a release agent to hauling units. Loads with excessive amounts of release agent will be rejected. Do not place crusted HMA in the paver.

Loads will be rejected, immediately prior to placement, with a temperature either below 250 °F (225 °F when using a warm mix chemical additive) or greater than 20 °F from the recommended maximum mixing temperature specified by the binder producer.

GENERAL SPECIFICATIONS FOR PAVEMENT- JOINT & CRACK SEALING

1.00 **WORK INCLUDED**: The work included consists of all equipment, labor and materials for removing old joint sealer, cleaning the joints and sealing with hot poured rubber-asphalt type joint sealing compound which shall conform to the requirements under each item of the Contract.

1.01 **JOINT CLEANING EQUIPMENT**: The equipment used for cleaning and preparing the joints and cracks for sealing in existing pavement shall include the following:

A. A tractor-mounted plow equipped with a hydraulically operated depth control and replaceable bits shall be used to remove the bulk of old material from the joints. This equipment shall be designed and operated to prevent spalling or otherwise damaging the concrete.

B. Routing-resurfacing machine - A self-powered machine operating a rotary cutter or revolving cutting tool designed to completely remove the old joint seal and all foreign matter and to reface each side wall of the joint without spalling or otherwise damaging the edges.

C. Air compressor - Air compressors shall be portable and capable of furnishing not less than 100 cubic feet of air per minute at a pressure not less than 90 pounds per square inch (psi). Suitable traps shall be employed to maintain the compressed air free of oil and moisture.

D. Sand blasting - Sand blasting equipment shall furnish a minimum of 300 cubic feet of air per minute at a pressure of not less than 90 psi. The nozzle shall be of proper size and of a long wearing type. Nozzles enlarged by wear shall be replaced as necessary.

1.02 **EQUIPMENT FOR FILLING AND SEALING JOINTS**: For Hot-Poured Rubber-Asphalt Type Compound - The heating kettle, for hot-poured rubber-asphalt type sealer, shall be indirect heating or double boiler, using oil as the heat transfer medium. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath. The Contractor may be required to demonstrate that the equipment proposed for use will consistently produce a joint sealer of proper pouring consistency.

When a separate pouring pot is used, it shall be of the indirect heating or double-boiler type, using oil as the heat transfer medium. It shall have a thermostatically controlled heat source, a built-in automatic agitator and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath. The pouring pot shall be mounted on rubber-tired wheels. On projects where the material requirements for continuous operating do not exceed the capacity of the pour pot, the mechanical pour pot may be used for both melting and applying the material.

When the hot-poured sealing material is applied directly from the heating kettle, the kettle shall be equipped with a pressure pump, hose and nozzle suitable for forcing the sealing material to the bottom of the joint and completely filling the joint. The hose and nozzle shall maintain the temperature of the sealing material so that the loss in temperature is not over 10^{o}F between the nozzle and the heating tank. Heat from a direct flame on the nozzle shall maintain the temperature of the sealing material so that the loss in temperature is not over 10^{o}F between the nozzle and the heating tank.

Heat from a direct flame on the nozzle shall not be used to maintain the proper temperature of the sealing material. The heating equipment shall be mounted on rubber-tired wheels and only rubber-tired equipment shall be used to move the heating equipment on the pavement.

1.03 **CONSTRUCTION METHODS**: The following procedure shall be used in re-sealing joints and cracks in pavements:

A. Removing old sealer - The old joint and foreign matter shall be plowed out of the expansion joints to the existing filler or to a depth of one inch, whichever is less, and the contraction joints shall be plowed to a depth of one and one-half inches. Previously sealed open cracks shall be cleaned to new concrete by routing with a joint cleaning machine. The removal of the old joint material from transverse joints shall be done using a plow blade of the proper size and shape attached to a garden tractor as described herein.

B. Joint excavating equipment making at least one pass each way, starting as near the curb as possible and proceeding to the centerline and then back to the edge. The vertical faces of transverse joints shall then be cleaned to the depth to which the joint material has been removed with a joint cleaning machine as herein described.

C. Routing-refacing machine - In addition, at least one pass shall be made on each side of transverse joints with a joint cleaning machine equipped with a scarifying head to clean the pavement surface completely to at least one inch each side of the joint groove. The vertical faces of the joint shall then be further cleaned with a wire brush, making one pass against each joint wall. When necessary, hand tools shall be used to remove any material not removed by mechanical cleaning. All old joint material and other debris removed from the joints or cracks shall be removed from the pavement immediately and disposed of by the Contractor in a manner satisfactory to the Engineer.

D. Sandblasting - Prior to the application of the sealer material, all joints or cracks will be thoroughly cleaned by sandblasting. This operation will be performed in such a manner as to result in the complete removal of all sidewalls and upper edges of the joint. The sandblasting shall continue until the entire joint space is free of dust, oil, water, old joint material and / or any other objectionable foreign matter which may prevent bonding of the sealing compound to the concrete. The sand used shall be of proper size and quality necessary for the operation.

E. Air - Following sandblasting operations, the joints and cracks will be thoroughly cleaned by means of an air jet under a pressure of not less than 90 psi. Compressed air may be used at any time during joint cleaning operations; however, to ensure removal of all loose material, a jet of compressed air will be required immediately ahead of sealing operations.

F. Debris Removal - All debris and objectionable material resulting from cleaning operations will be removed from the pavement surface prior to sealing operations and disposed of by the Contractor at a recognized disposal area.

1.04 **SEALING JOINTS WITH HOT-POURED SEALANT**: As soon as the joints are cleaned with the compressed air jet, they shall be sealed with hot-poured rubber-asphalt type compound. No joints shall be sealed until the cleaning and preparation of the joints have been inspected and approved by the Engineer.

Contraction joints, construction joints and expansion joints that have openings for the full depth of the slab shall be caulked with closed cell foam backer rod to prevent the sealing compound from flowing down to the subgrade.

For expansion joints, the closed cell foam backer rod caulking material shall not extend above the pre-molded joint filler. Contraction joints and construction joints shall have a space of one inch to one and one-half inch above the caulking material that shall be filled with the sealing compound.

Hot-poured or cold-applied joint sealant shall be applied with pressure equipment with a nozzle extending into the groove so as to completely fill the groove with sealing compound.

Immediately after the joints are cleaned, the joints shall be sealed. The surface of the concrete shall be dry at the time of sealing. The hot-poured joint sealant shall be melted in a heating kettle. Direct heating will not be permitted. Any sealing material heated in excess of the safe heating temperature recommended by the manufacturer shall not be used in the work.

Pouring shall be done by the use of a separate pouring pot of the double-boiler type or from the melting kettle equipped with a pressure pump, hose, and nozzle. When approved by the Engineer, the hot-poured joint sealant may be poured with a hand-type pouring pot, provided a satisfactory joint is obtained. If the hand-type pouring pot does not produce a satisfactory joint, its use shall be discontinued and the equipment shall force the sealing material to the bottom of the joint and completely fill it to the surface of the pavement. Any sealant spilled on the surface of the pavements shall be removed.

The sealant shall not be placed when the temperature is less than 50^{o}F except by the approval of the Engineer. Traffic shall not be permitted over the poured joint until the sealant has hardened sufficiently to resist pickup. When joint sealing work is done during periods when the pavement is contracted, as occurs during the colder months, joints shall be filled to no more than 1/8 inch below the slab surface. When joints are sealed during hot weather periods when the pavement is expanded, they should be poured flush with the slab surface.

1.05 **MATERIAL**: Material to be placed shall conform to Section 914.04 of the MDOT 2020 Standard Specifications for Construction.

1.06 **PREPARATION OF THE SEALING COMPOUND**: Regular Joint Sealer - This type sealer shall be heated to and poured at temperatures recommended by the manufacturer. This compound shall not be heated in excess of 450^{o}F and direct heating will not be permitted at any time. Heating contrary to these conditions and limitations will be sufficient cause to reject the material so handled. If operations, including shutdown overnight, halt the pouring for extended periods, heat input into the melting kettle shall be cut off. Reheating will be permitted only once.

1.07 **FINAL CLEANUP**: The work shall not be considered as completed nor will final payment be made until the area has been restored to a neat, orderly appearance acceptable to the Engineer. Equipment, excess material, rubbish, etc., resulting from the Contractor's operation must be removed from the site. Any costs incurred for final cleanup shall be incidental to the Contract.

2.00 OPERATION

2.01 PREPARE, CLEAN & RE-SEAL LONGITUDINAL & TRANSVERSE JOINTS & CRACKS IN ASPHALT & CONCRETE RESIDENTIAL STREETS: The sealing compound shall meet all material and installation requirements specified in Sections 603 and 914.04 of the MDOT 2020 Standard Specifications for Construction.

2.02 PREPARE, CLEAN & RE-SEAL JOINTS & CRACKS IN NEW CONCRETE RESIDENTIAL STREETS: The sealing compound shall meet all material and installation requirements specified in Sections 603 and 914.04 of the MDOT 2020 Standard Specifications for Construction.

The Bond Breaker Rod shall be made of Polyolefin Foam - 1/2 inch diameter commonly referred to as "Backer Rod" (see PD-17). It shall be a closed cell and non-water absorbent material.

Saw-cutting the new pavement: The saw cut joint shall be of a width of 3/8 inch and a depth of 1 inch to enable installation of a 1/2 inch bond breaker - backer rod. The relief joint shall be 1/8 inch sawed to a depth of 1-½ inches for 6-inch concrete pavement, 2 inches for 7-inch concrete pavement, 2 inches for 8-inch concrete pavement, and 2.5 inches for 9-inch concrete pavement. For information, the preliminary basic joint layout shall be as follows for 27 foot wide concrete pavement:

Longitudinal Joints	Three (3) joints at pavement centerline and at each quarter width with backer rod
Transverse Joints	Maximum spacing of 1.5 times the longitudinal joint spacing with backer rod
Expansion Joints	Approximately 150 feet on center, average, to be sealed without backer rod

2.03 SEAL CONCRETE STREET PATCHES - RESIDENTIAL STREETS: CLEAN & SEAL JOINTS: The sealing compound shall meet all material and installation requirements specified in Sections 603 and 914.04 "Hot Poured Joint Sealant" of the MDOT 2012 Standard Specifications for Construction.

2.04 SEAL ASPHALT / CONCRETE MUNICIPAL PARKING LOTS: PREPARE, CLEAN & SEAL JOINTS & CRACKS: The sealing compound shall meet all material and installation requirements specified in Sections 603 and 914.04 "Hot Poured Joint Sealant" of the MDOT 2012 Standard Specifications for Construction.

2.05 METHOD OF MEASUREMENT: As follows:

A. Cleaning and Re-Sealing Longitudinal and Transverse Joints will be measured by length in linear feet, measured along the centerline of the joint.

B. Cleaning and Re-Sealing Cracks will be measured by length in lineal feet, measured in a straight line in the direction of the crack. Measurements shall be made each day by the Engineer and a foreman or representative of the Contractor. The daily measurements shall be agreed to in writing by all parties.

2.06 **BASIS OF PAYMENT**: Cleaning, re-sealing transverse and longitudinal joints, and sealing random cracks, will be paid for at the contract unit price per linear foot, which price shall be payment in full for furnishing all the materials, equipment and labor to remove the sealers, fillers and / or other foreign material, grinding, cleaning, caulking, saw-cutting, and / or sealing joints and cracks with the specified sealing compound and completing the work as specified herein. Joint details are shown on detail page PD-17. Sawcutting and sealing new concrete pavement is included in the unit price for concrete pavement.

GENERAL SPECIFICATIONS FOR PAVEMENT MARKINGS

1.0 **DESCRIPTION:** This work consists of providing and applying permanent pavement markings in accordance the plans and specifications provided, and in accordance with the MDOT 2020 Standard Specifications for Construction Sections 811 and 920.

Apply longitudinal lines with certified self-propelled pavement marking equipment. Operate marking equipment at no greater than the certified speed. Use equipment capable of uniformly applying material to the required length and width.

The pavement markings shall be laid out by the Contractor prior to the permanent markings being applied. The onsite Engineer must approve the layout prior to the marking application.

The pavement surface must be clean and dry before applying pavement markings. Air blast to remove material that prevents pavement markings from adhering to the pavement surface. Remove debris or dead animals from the line track.

For solid lines, apply 4 inch lines, 6 inch lines, 8 inch lines, and 12 inch lines, no greater than ¼ inch wider than the required width. Apply solid lines with no gaps or spaces. Apply a double line as either two solid lines or one solid line and one broken line.

When applying centerline and lane lines on new construction, retrace at least five existing adjacent skips to match the existing pavement marking cycle.

Mix liquid materials during application. Do not thin materials. Uniformly apply pavement marking material at the rates shown in Table 811-1 of the MDOT 2020 Standard Specifications for Construction and apply within the seasonal application restrictions in Table 811-2.

Position bead guns to direct beads into the line material and provide a uniform application of beads.

Apply pavement marking lines straight or in uniform curvature. Markings must be sharp, well-defined, free of uneven edges, overspray, or other visible defects, as determined by the Engineer. Remove pavement markings outside the required tolerances and re-apply in the correct locations.

When surface applying pavement markings on new concrete, remove the curing compound in accordance with subsection 812.03.F.

If removing special markings, including legends, symbols, crosswalks, cross hatching, and stop bars, install the new markings within 5 working days.

If the contract requires a second application of permanent pavement markings, complete two applications regardless of initial pavement marking conditions. Complete the second application from 14 days to 60 days after initial application in the same calendar year.

2.00 **POLYUREA MARKINGS:** The pavement must be free of excess surface and subsurface moisture that mayaffect bonding. The Engineer will not decide the suitability of specific days for the applicationof polyurea.

Surface preparation requirements for special and longitudinal polyurea pavement markings depend on surface conditions.

Prepare new HMA surfaces and HMA surfaces open to traffic for 10 days or less with no oil drips, residue, debris, or temporary or permanent markings, by cleaning the marking area with compressed air.

Prepare new Portland cement concrete (PCC) surfaces and PCC surfaces free of oil drips, residue, and debris, temporary, or permanent markings, by removing the curing compound from the area required for pavement markings.

Prepare existing HMA or PCC surfaces that do not have existing markings, but may have oil drip areas, debris, or both, by scarifying the marking area using non-milling grinding teeth or shot blasting. The Engineer will allow the use of water blasting to scarify the marking area on PCC surfaces.

Prepare existing HMA or PCC surfaces with existing non-polyurea markings by completely removing non-polyurea markings.

Prepare existing HMA or PCC surfaces with existing polyurea marking and that may have oildrip areas, debris, or both, by using the following methods:

A. For existing polyurea pavement markings, scarify the proposed marking area using non-milling grinding teeth or shot blast.

B. Occasionally existing polyurea pavement markings will require complete removal, which will be determined by the Engineer.

3.00 THERMOPLASTIC PAVEMENT MARKINGS

3.01 **DESCRIPTION OF WORK**: This work covers the furnishing and installation of hot-applied thermoplastic pavement markings at locations as designated by the Engineer, the plans and / or the proposal.

3.02 **MATERIAL**: The material shall be specifically formulated for thermoplastic pavement markings and meet the composition requirements of Paragraph 4.2 of AASHTO M249-79I. The material shall resist discoloration during melting and subsequent exposure as pavement markings. The glass beads shall conform to the requirements of Paragraph 3.2 of AASHTO M249-79I and shall be included in the material and dropped on at the time of application.

3.03 **COLOR**: As follows:

A. White – The luminous directional reflectivity shall not be less than 80 percent relative to magnesium oxide when tested in accordance with the current ASTM E 97.

B. Yellow – Shall be within the limits of the Color Tolerance Chart for Highway Yellow, PR Color #1 of the Federal Highway Administration, except that the green tolerance limit shall have CIE coordinates of X=0.491 and Y=0.460 and except that the

minimum lightness shall be 50.7 percent. Tests will be conducted in accordance with ASTM E 308, using Standard Illuminant C.

3.04 **THICKNESS**: The applied line, in the designated color, shall have a thickness of 0.099" ± 0.015".

3.05 **APPLICATION**: Use of hot-applied thermoplastic material shall be limited to bituminous Installation of pavement surfaces. The thermoplastic material shall be extruded or sprayed by the Contractor with truck-mounted or small hand-operated pavement marking equipment approved by the Engineer. The equipment shall be capable of placing white or yellow markings of the widths and types specified, and the markings shall be in conformance with the current edition of the Michigan Manual of Uniform Traffic Control Devices. An adhesive primer (a type recommended by the supplier) shall be applied prior to application of the thermoplastic material and / or primer. The minimum air temperature shall be 50°F upon application and the material shall be applied at a minimum of 375°F.

If existing markings to be retraced consist of thermoplastic material, any thermoplastic material with poor adhesion to pavement surface shall be removed to the extent determined by the Engineer, and the surface cleaned prior to application of adhesive primer and new marking material.

3.06 **DRYING TIME**: Drying time shall meet the requirements of Paragraph 4.3.2 of AASHTO M249-79I.

3.07 **METHOD OF MEASUREMENT**: The method of measuring quantities for payment shall be the number of linear feet of appropriate width, and / or number of symbol and legend units, installed and accepted.
Railroad markings shall consist of "RXR" legend only. Accompanying transverse bars shall be bid separately on a linear foot basis.

3.08 **BASIS OF PAYMENT**: These items will be paid for at the contract unit price for Thermoplastic Pavement Markings, legend, and symbols, of the color, width, and type specified.

Cleaning of the road surface, sand blasting, and use of a primer of the type and quantity as specified by the supplier shall be incidental to the Contract. Removal of existing thermoplastic and / or cold plastic material shall be considered incidental to the project.

3.09 **DELAYED ACCEPTANCE OF WORK**: Acceptance of completed hot-applied thermoplastic pavement marking work will be delayed 180 days. During this 180-day period, inspections of the markings placed in accordance with the Contract will be conducted at the Engineers discretion. Markings with less than 90 percent of the original marking in place shall be replaced at the Contractor's expense.

If the Contractor wishes to have the project accepted for final payment prior to the 180 day delay period, he must, when the balance of the Contract work has been satisfactorily completed, furnish the City / County with a maintenance bond equal in value to 90 percent of the value of the thermoplastic pavement marking work performed.

4.00 **COLD PLASTIC PAVEMENT MARKINGS**

4.01 **DESCRIPTION OF WORK**: This work covers the furnishing and installation of cold plastic pavement markings at locations as designated by the Engineer, the plans and / or the proposal.

4.02 **MATERIALS**: The preformed reflectorized pavement markings film shall consist of a nonporous homogeneous mixture of resins, plasticizers, fillers, pigments, and glass beads, uniformly distributed throughout the material. An added layer of reflective beads are to be bonded to the top surface. The marking material shall be capable of being affixed to bituminous and / or concrete pavement by pressure sensitive pre-coated adhesive or liquid contact cement in accordance with manufacturer's recommendations. Material shall be required to mold itself to the pavement contours, breads, faults, etc., by the initial action of applicator and / or traffic impact. The material shall not split, crack, perforate, or shift during the delayed acceptance period. Also, the material shall be formulated so that it will have resealing characteristics and be able to fuse itself with previously applied plastic marking materials. There shall be no tearing or other failure of the protective paper, if used, during removal of the sample.

4.03 **COLOR**: The white and yellow cold plastic markings shall conform to standard highway chart colors throughout the expected life of the material, and show no dark or black areas both day and night. Color tolerance limits after one year shall be no less than 25 percent of the original using the ASTM E 308 procedure.

A. White - The luminous directional reflectivity shall not be less than 80 percent relative to magnesium oxide when tested in accordance with the current ASTM E 97.

B. Yellow: - Shall be within the limits of the Color Tolerance Chart for Highway Yellow, PR Color #1 of the Federal Highway Administration, except that the green tolerance limit shall have C.I.E. coordinates of X=0.491 and Y=0.460 and the minimum lightness shall be 50.7 percent. Tests will be conducted in accordance with ASTM E 308, using Standard Illuminant C.

4.04 **REFLECTIVITY**: The material shall have the following initial minimum reflectance values at 0.2°and 0.5° observation angles and 86.0° entrance angle as measured in accordance with the testing procedures of Federal Test Method Standard 370. The photometric quantity measured is specific luminance (SL), and is measured as millicandelas per square foot per footcandle [(mod ft^{-2}) fc^{-1}].

	White		Yellow	
Observation angle	0.2°	0.5°	0.2°	0.5°
Specific luminance [(mod ft^{-2}) fc^{-1}].	550	380	410	250

4.05 **REFLECTIVITY RETENTION**: The glass beads must be strongly bonded and not easily removed by traffic wear.

The material shall be capable of passing the following bead retention test:

Taber Abraser Simulation Test

Using a Taber Abraser with an H-18 wheel and a 125 gram load, the sample shall be inspected at 200 cycles under a microscope to observe the extent and type of bead failure.

No more than 15 percent of the beads shall be lost due to popout, and the predominant mode of failures shall be "wear down" of the beads.

4.06 **THICKNESS**: The material shall have a film thickness of 0.060 ± 0.010 inches (excluding thickness of adhesives).

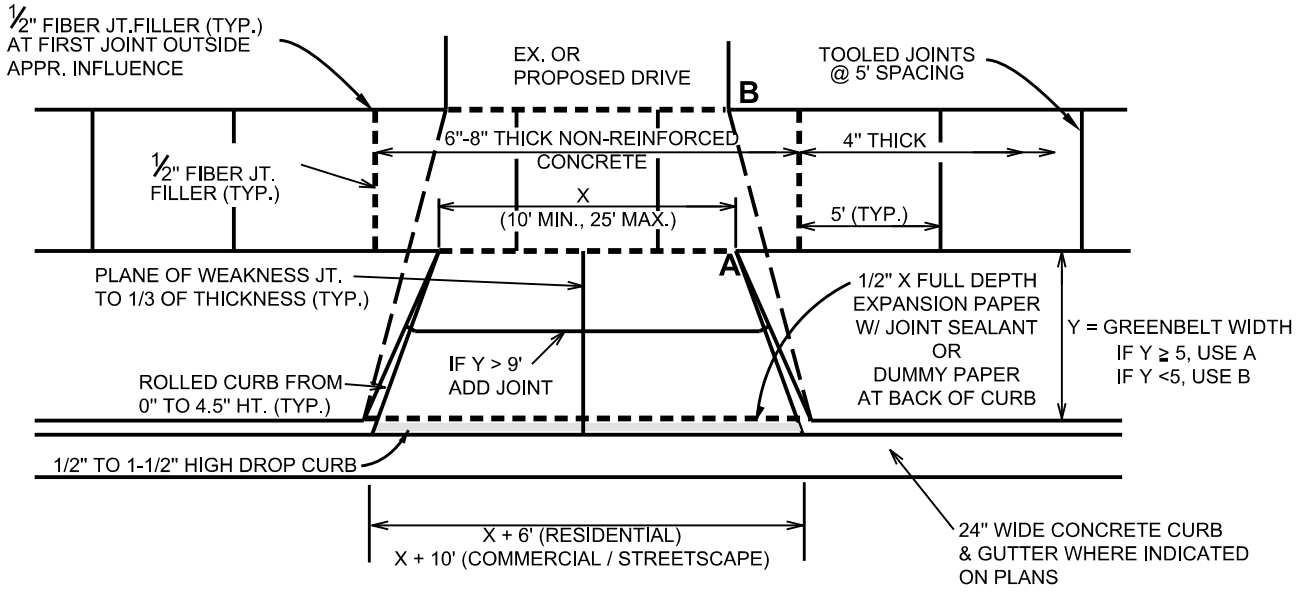
4.07 **TENSILE STRENGTH AND ELONGATION**: The film shall have a minimum tensile strength of 150 pounds per square inch of cross-section when tested according to ASTM D 638-76. A 6 inch x 1 inch sample tested at a temperature between 70°F and 80°F using jaw speeds of 10 to 12 inches per minute shall have a minimum elongation of 35 percent at break when tested by methods described in ASTM D 638-61t.

4.08 **STATIC LOAD STRENGTH**: The test specimen cut to dimensions of 6 inch x 1 inch shall be capable of supporting a dead load weight of 5 pounds for no less than 30 minutes. This test shall be conducted at a temperature of 70°F to 80°F.

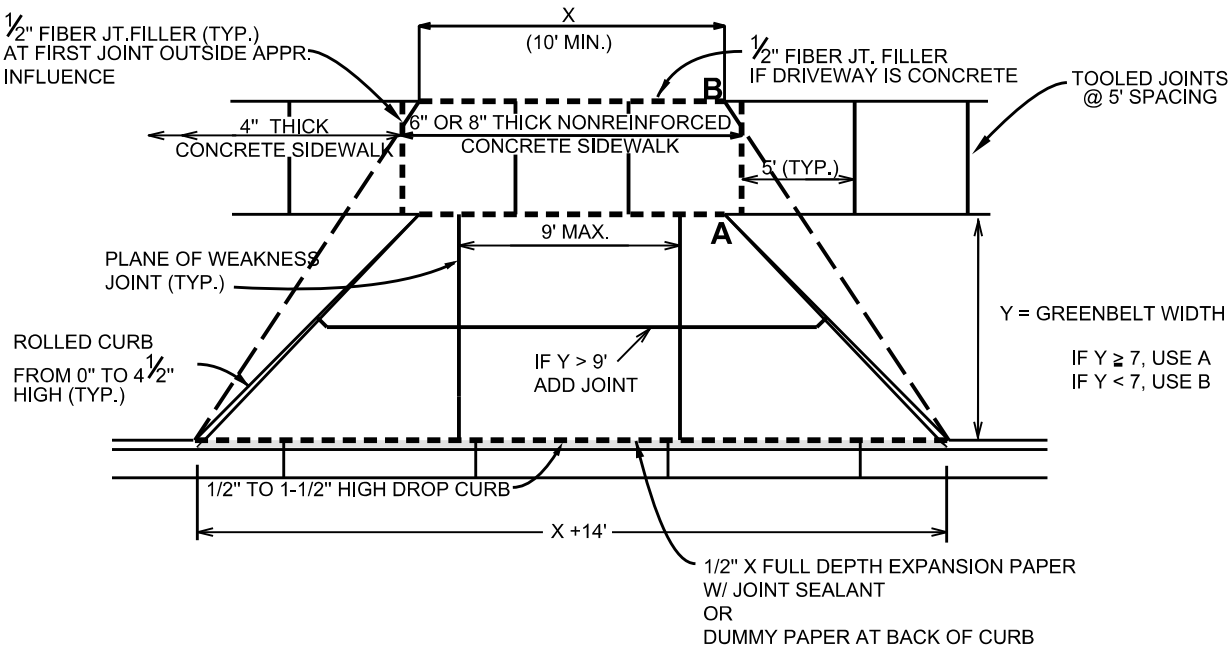
4.09 **PATCHABILITY**: The pavement marking film shall be capable of use for patching work areas of any type of cold plastic material in accordance with supplier's instructions.

4.10 **SKID RESISTANCE**: The surface of the pavement marking shall provide an initial minimum skid resistance value of 45 BPN when tested according to ASTM E 303.

PAVING DETAILS



DRIVEWAY APPROACH & SIDEWALK DETAIL - LOCAL ROADS



DRIVEWAY APPROACH & SIDEWALK DETAIL - MAJOR ROADS

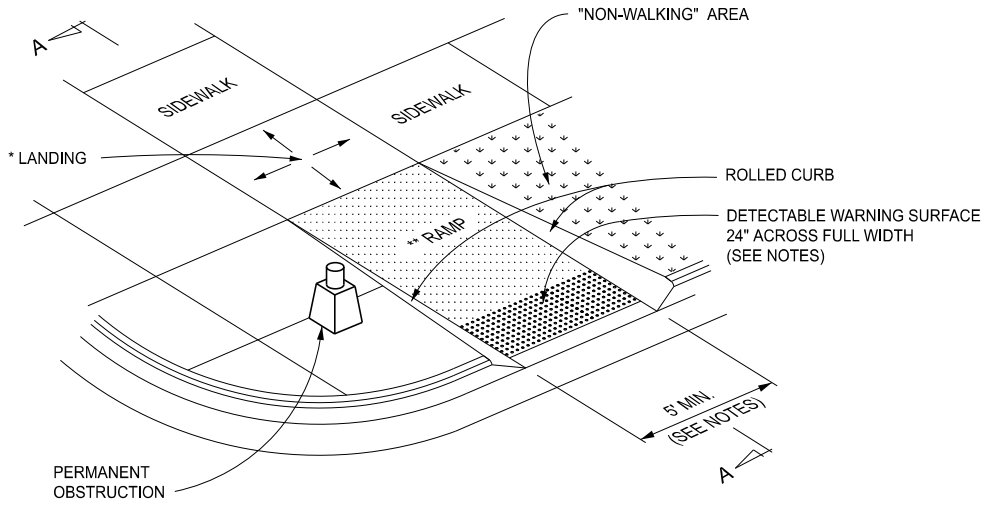
NOTES:
1. CONCRETE APPROACH AND ADJACENT SIDEWALK THICKNESS SHALL BE AS FOLLOWS:

   6" - RESIDENTIAL
   8" - NON-RESIDENTIAL / COMMERCIAL AND DOWNTOWN STREETSCAPE

2. DRIVEWAY APPROACHES SHALL HAVE A MAXIMUM SLOPE OF 10%.

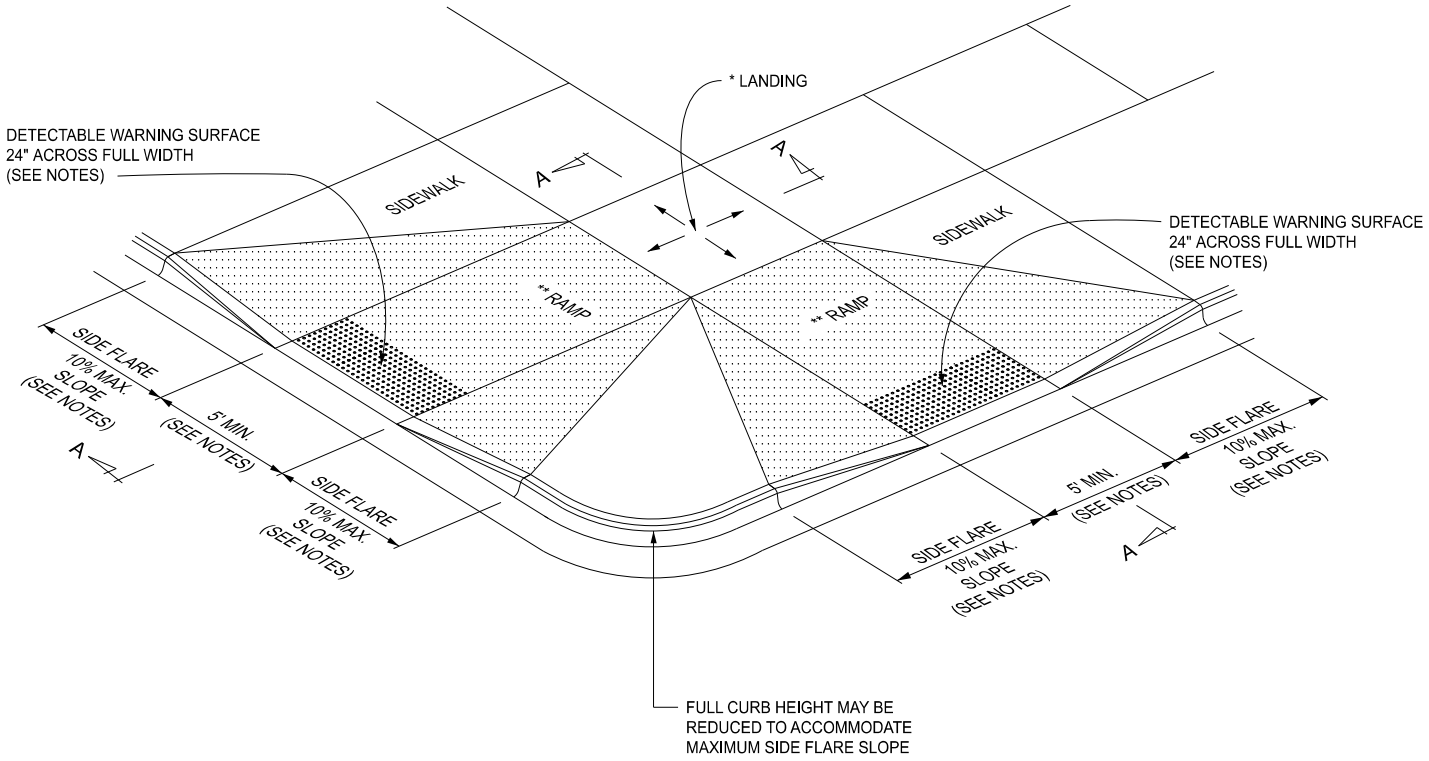
* MAXIMUM LANDING SLOPE IS 2.1% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.1%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



CURB RAMP TYPE R

(ROLLED SIDES)



CURB RAMP TYPE F

(FLARED SIDES, TWO RAMPS SHOWN)

APPROVED BY: _____
DIRECTOR, BUREAU OF FIELD SERVICES

APPROVED BY: _____
DIRECTOR, BUREAU OF DEVELOPMENT

MDOT
Michigan Department of Transportation

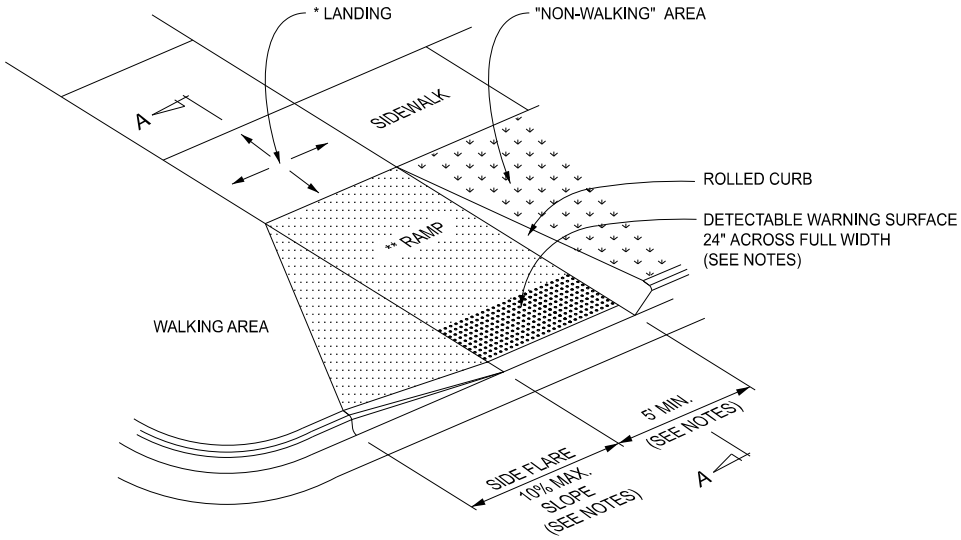
DEPARTMENT DIRECTOR
BRADLEY C. WIEFERICH, PE

STANDARD PLAN FOR
CURB RAMP AND
DETECTABLE WARNING DETAILS

(SPECIAL DETAIL) FHWA APPROVAL	11/08/2023 PLAN DATE	R-28-K	SHEET 1 OF 7

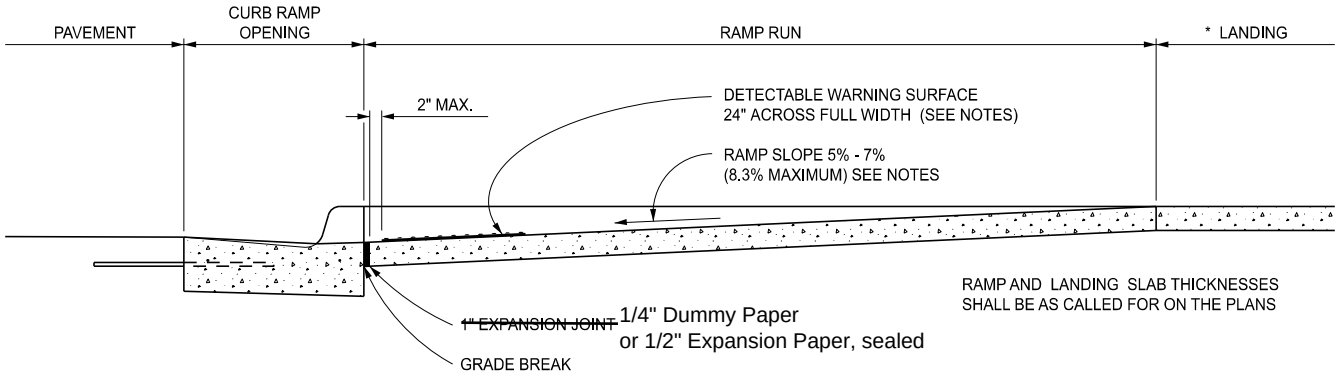
* MAXIMUM LANDING SLOPE IS 2.1% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.1%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



CURB RAMP TYPE RF

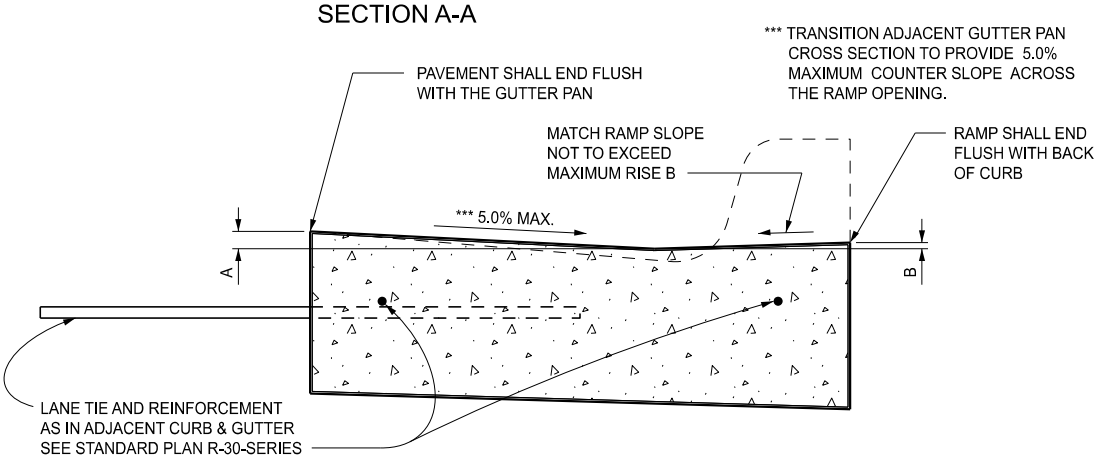
(ROLLED / FLARED SIDES)



SECTION A-A

CURB TYPE	MAXIMUM RISE (INCHES)	
	A	B
B1	¾	1
B2	¾	1
B3	¾	1
D1	¾	1
D2	¾	1
D3	¾	1
C1	½	½
C2	½	½
C3	¾	½
C4	¾	½
C5	1	½
C6	1	½
F1	½	½
F2	½	½
F3	¾	½
F4	¾	½
F5	1	½
F6	1	½

FOR CURB TYPES SEE STANDARD PLAN R-30-SERIES



SECTION THROUGH CURB RAMP OPENING

(TYPICAL ALL RAMP TYPES)

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STANDARD PLAN FOR
CURB RAMP AND
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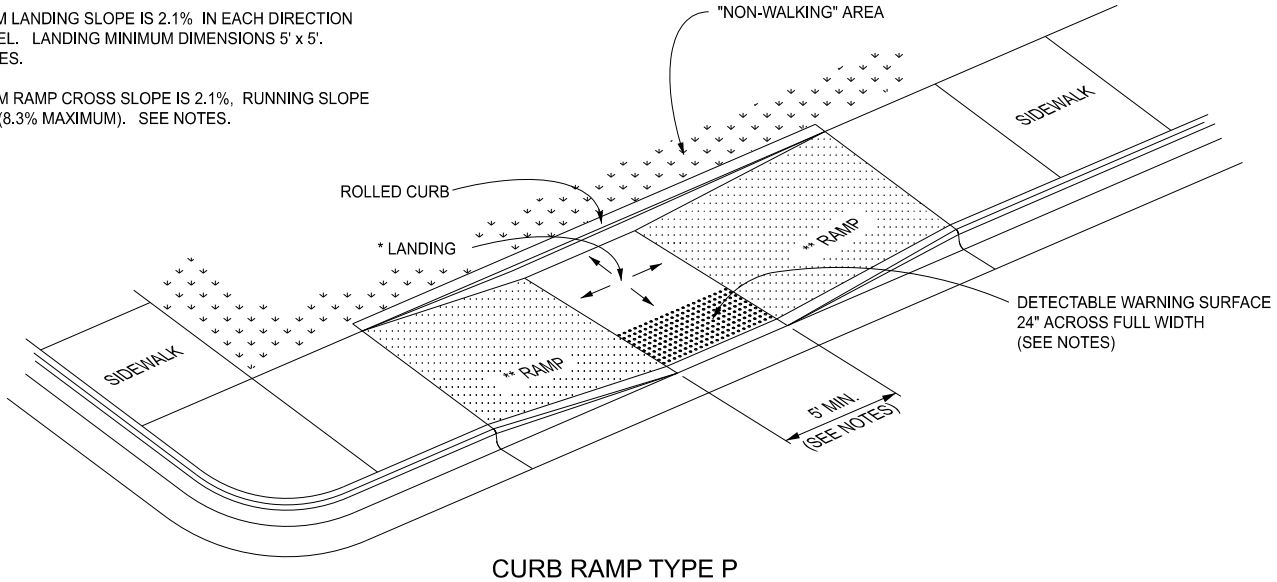
(SPECIAL DETAIL) FHWA APPROVAL	11/08/2023 PLAN DATE	R-28-K	SHEET 2 OF 7

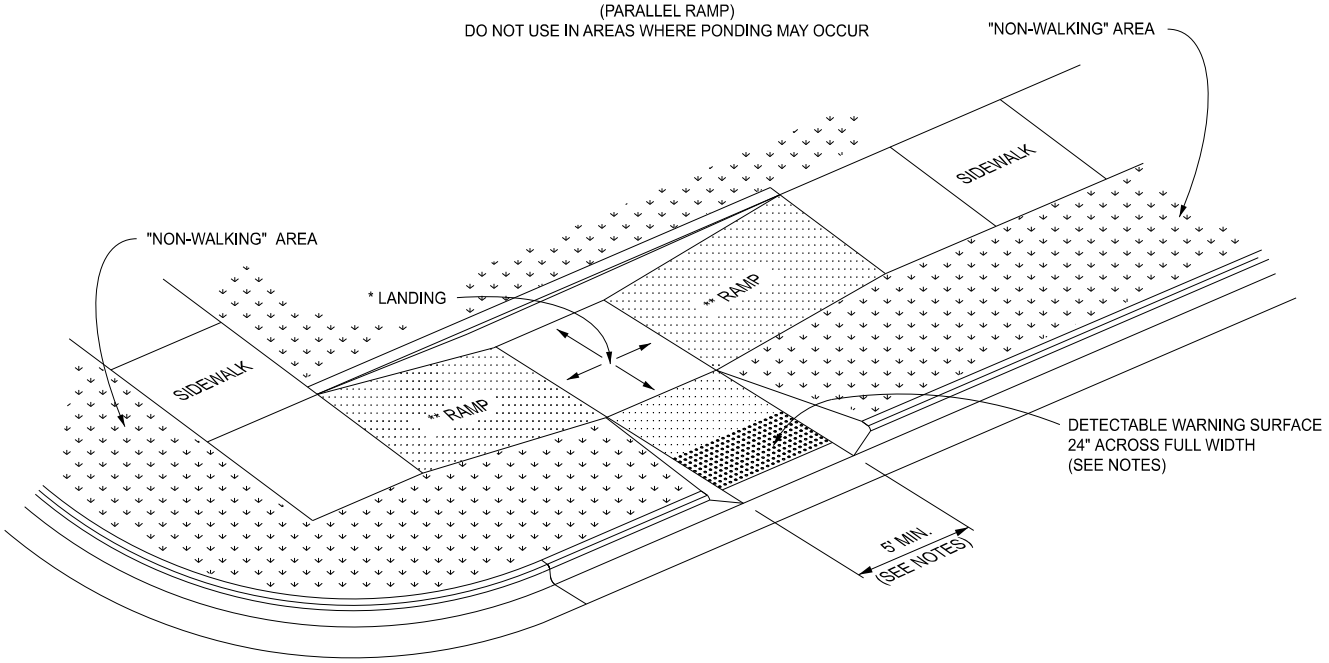
* MAXIMUM LANDING SLOPE IS 2.1% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.1%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



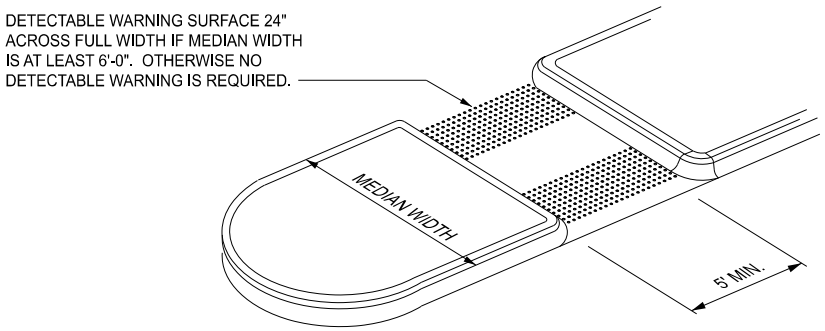
CURB RAMP TYPE P

(PARALLEL RAMP)
DO NOT USE IN AREAS WHERE PONDING MAY OCCUR



CURB RAMP TYPE C

(COMBINATION RAMP)



CURB RAMP TYPE M

(MEDIAN ISLAND)

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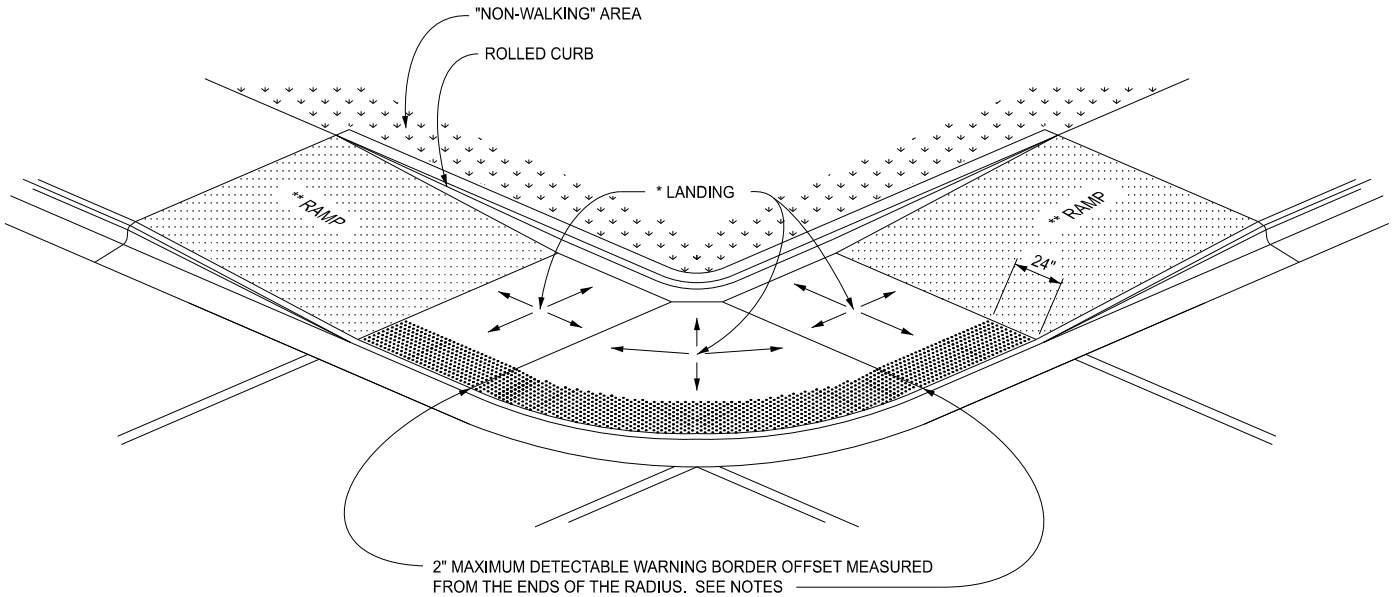
STANDARD PLAN FOR
CURB RAMP AND
DETECTABLE WARNING DETAILS

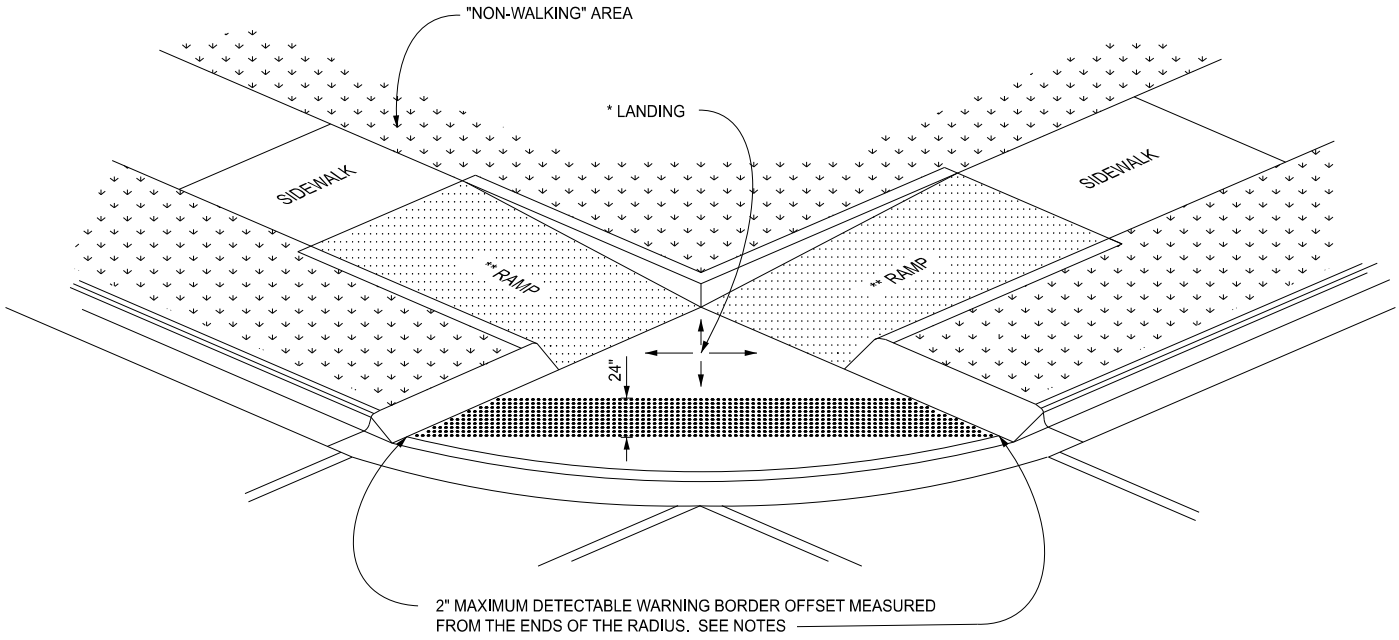
(SPECIAL DETAIL) / FHWA APPROVAL	11/08/2023 / PLAN DATE	R-28-K	SHEET 3 OF 7

* MAXIMUM LANDING SLOPE IS 2.1% IN EACH DIRECTION OF TRAVEL. LANDING MINIMUM DIMENSIONS 5' x 5'. SEE NOTES.

** MAXIMUM RAMP CROSS SLOPE IS 2.1%, RUNNING SLOPE 5% - 7% (8.3% MAXIMUM). SEE NOTES.



(RADIAL DETECTABLE WARNING SHOWN)



(TANGENT DETECTABLE WARNING SHOWN)

CURB RAMP TYPE D

(DEPRESSED CORNER)

USE ONLY WHEN INDEPENDENT DIRECTIONAL RAMPS CAN NOT BE CONSTRUCTED FOR EACH CROSSING DIRECTION

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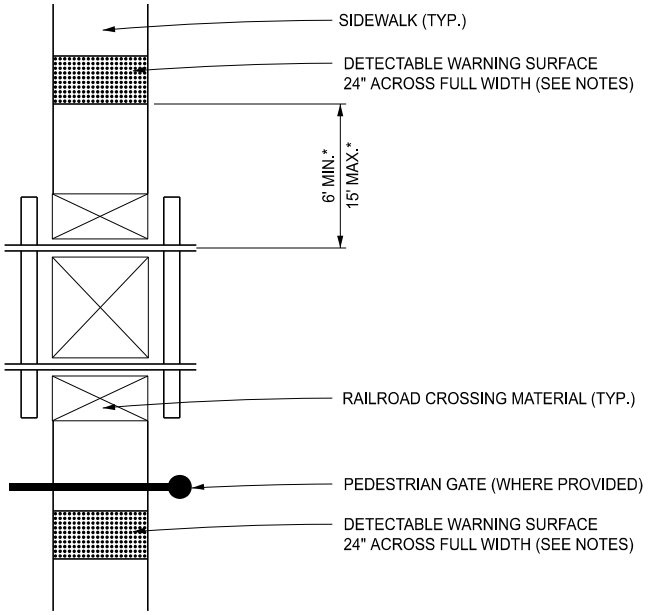
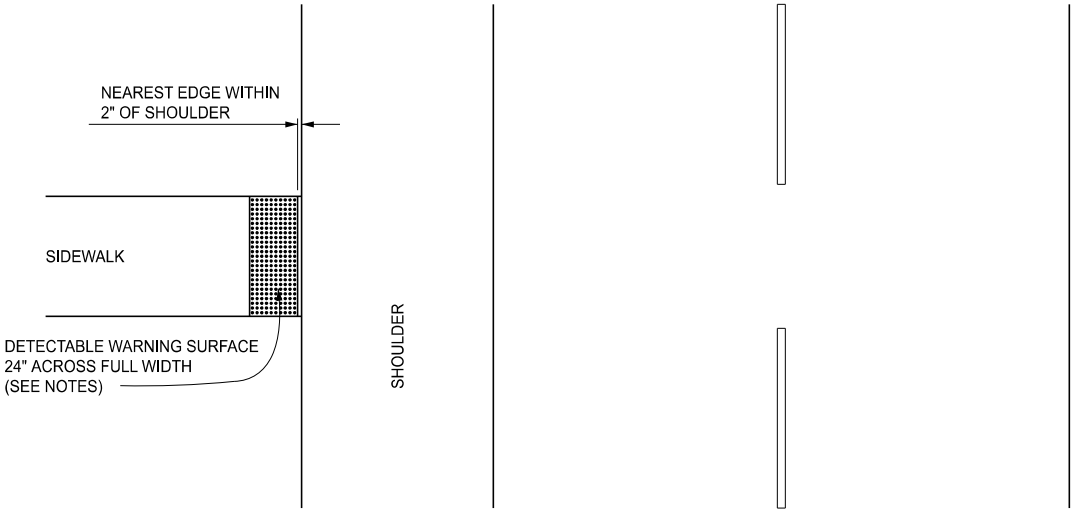
STANDARD PLAN FOR
CURB RAMP AND
DETECTABLE WARNING DETAILS

(SPECIAL DETAIL) FHWA APPROVAL	11/08/2023 PLAN DATE	R-28-K	SHEET 4 OF 7

* THE DETECTABLE WARNING SURFACE SHALL BE LOCATED SO THAT THE EDGE NEAREST THE RAIL CROSSING IS 6' MINIMUM AND 15' MAXIMUM FROM THE CENTERLINE OF THE NEAREST RAIL. DO NOT PLACE DETECTABLE WARNING ON RAILROAD CROSSING MATERIAL.



DETECTABLE WARNING AT RAILROAD CROSSING



DETECTABLE WARNING AT FLUSH SHOULDER OR ROADWAY

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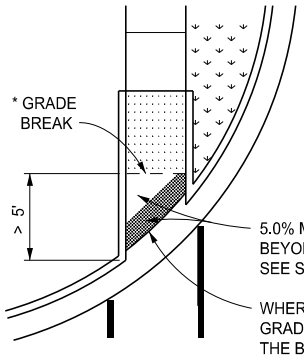
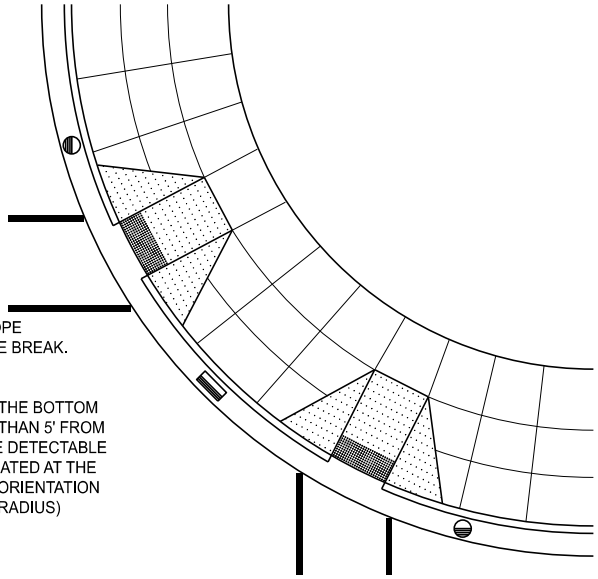
STANDARD PLAN FOR
CURB RAMP AND
DETECTABLE WARNING DETAILS

(SPECIAL DETAIL) FHWA APPROVAL	11/08/2023 PLAN DATE	R-28-K	SHEET 5 OF 7



CURB RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK OFFSET GREATER THAN 5')

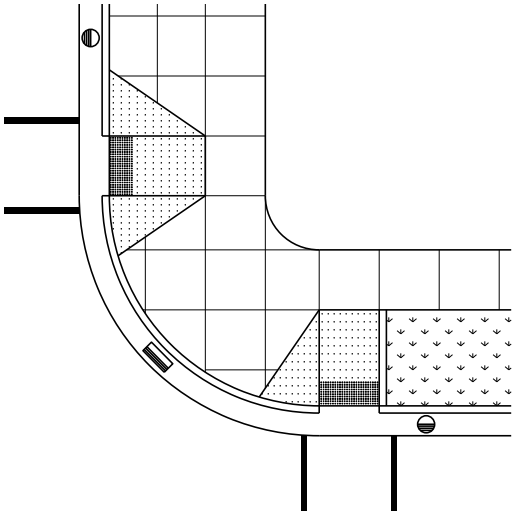


CURB RAMP PERPENDICULAR TO RADIAL CURB (TYPE F SHOWN)

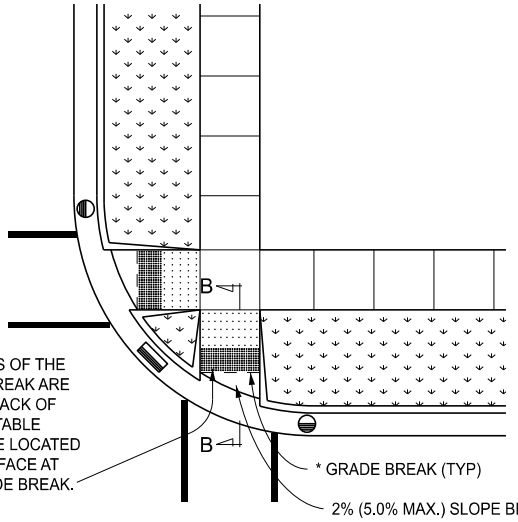
(USE WITH RADIAL CURB WHEN THE CROSSWALK AND CURB RAMP ARE NOT ALIGNED)

LEGEND

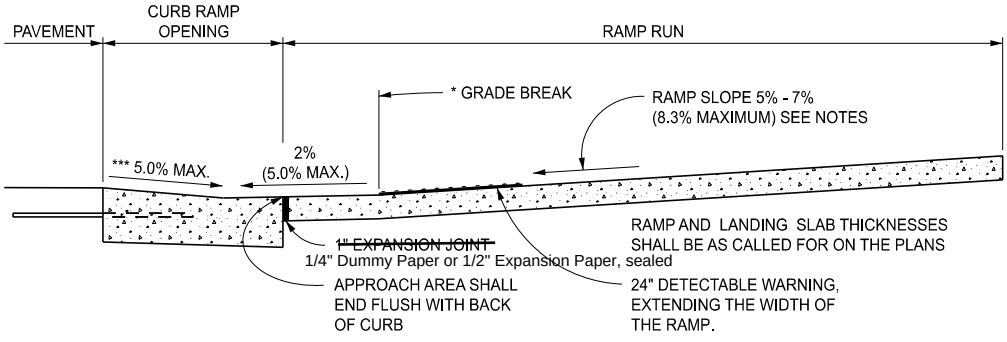
- SLOPED SURFACE
- DETECTABLE WARNING
- "NON-WALKING" AREA
- CROSSWALK MARKING
- PREFERRED LOCATION OF DRAINAGE INLET (TYP.)
- ALTERNATE LOCATION OF DRAINAGE INLET (TYP.)



CURB RAMP PERPENDICULAR TO TANGENT CURB
(TYPE F AND TYPE RF SHOWN)



CURB RAMP LOCATED IN RADIUS (TYPE R SHOWN)
(GRADE BREAK OFFSET LESS THAN 5')



* GRADE BREAKS AT THE TOP AND BOTTOM OF CURB RAMPS SHALL BE PERPENDICULAR TO THE DIRECTION OF TRAVEL.

*** TRANSITION ADJACENT GUTTER PAN CROSS SECTION TO PROVIDE 5.0% MAXIMUM COUNTER SLOPE ACROSS THE RAMP OPENING.

SEE SHEET 2 FOR CURB RAMP OPENING DETAILS.

SECTION B-B

CURB RAMP ORIENTATION

MDOT Michigan Department of Transportation

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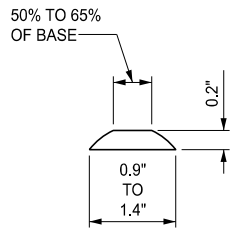
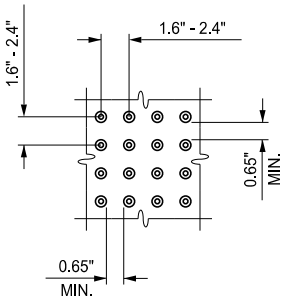
STANDARD PLAN FOR
CURB RAMP AND
DETECTABLE WARNING DETAILS

(SPECIAL DETAIL) / FHWA APPROVAL	11/08/2023 / PLAN DATE	R-28-K	SHEET 6 OF 7

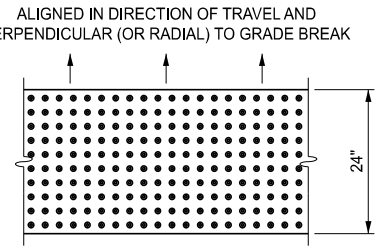
Detail provided for convenience. Follow most current MDOT Detail R-28 plans



DOME SECTION



DOME SPACING



DOME ALIGNMENT

DETECTABLE WARNING DETAILS

NOTES:

DETAILS SPECIFIED ON THIS PLAN APPLY TO ALL CONSTRUCTION, RECONSTRUCTION, OR ALTERATION OF STREETS, CURBS, OR SIDEWALKS IN THE PUBLIC RIGHT OF WAY.

CURB RAMPS ARE TO BE LOCATED AS SPECIFIED ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

RAMPS SHALL BE PROVIDED AT ALL CORNERS OF AN INTERSECTION WHERE THERE IS EXISTING OR PROPOSED SIDEWALK AND CURB. RAMPS SHALL ALSO BE PROVIDED AT MARKED AND/OR SIGNALIZED MID-BLOCK CROSSINGS.

SURFACE TEXTURE OF THE RAMP SHALL BE THAT OBTAINED BY A COARSE BROOMING, TRANSVERSE TO THE RUNNING SLOPE.

SIDEWALK SHALL BE RAMPED WHERE THE DRIVEWAY CURB IS EXTENDED ACROSS THE WALK.

CARE SHALL BE TAKEN TO ASSURE A UNIFORM GRADE ON THE RAMP. WHERE CONDITIONS PERMIT, IT IS DESIRABLE THAT THE SLOPE OF THE RAMP BE IN ONLY ONE DIRECTION, PARALLEL TO THE DIRECTION OF TRAVEL.

RAMP WIDTH SHALL BE INCREASED, IF NECESSARY, TO ACCOMMODATE SIDEWALK SNOW REMOVAL EQUIPMENT NORMALLY USED BY THE MUNICIPALITY.

WHEN 5' MINIMUM WIDTHS ARE NOT FEASIBLE, RAMP WIDTH MAY BE REDUCED TO NOT LESS THAN 4' AND LANDINGS TO NOT LESS THAN 4' x 4'.

CURB RAMPS WITH A RUNNING SLOPE ≤ 5% DO NOT REQUIRE A TOP LANDING. HOWEVER, ANY CONTINUOUS SIDEWALK OR PEDESTRIAN ROUTE CROSSING THROUGH OR INTERSECTING THE CURB RAMP MUST INDEPENDENTLY MAINTAIN A CROSS SLOPE NOT GREATER THAN 2.1% PERPENDICULAR TO ITS OWN DIRECTION(S) OF TRAVEL.

DETECTABLE WARNING SURFACE COVERAGE IS 24" MINIMUM IN THE DIRECTION OF RAMP/PATH TRAVEL AND THE FULL WIDTH OF THE RAMP/PATH OPENING EXCLUDING CURBED OR FLARED CURB TRANSITION AREAS. A BORDER OFFSET NOT GREATER THAN 2" MEASURED ALONG THE EDGES OF THE DETECTABLE WARNING IS ALLOWABLE. FOR RADIAL CURB THE OFFSET IS MEASURED FROM THE ENDS OF THE RADIUS.

FOR NEW ROADWAY CONSTRUCTION, THE RAMP CROSS SLOPE MAY NOT EXCEED 2.1%. FOR ALTERATIONS TO EXISTING ROADWAYS, THE CROSS SLOPE MAY BE TRANSITIONED TO MEET AN EXISTING ROADWAY GRADE. THE CROSS SLOPE TRANSITION SHALL BE APPLIED UNIFORMLY OVER THE FULL LENGTH OF THE RAMP.

THE MAXIMUM RUNNING SLOPE OF 8.3% IS RELATIVE TO A FLAT (0%) REFERENCE. HOWEVER, IT SHALL NOT REQUIRE ANY RAMP OR SERIES OF RAMPS TO EXCEED 15 FEET IN LENGTH NOT INCLUDING LANDINGS OR TRANSITIONS.

DRAINAGE STRUCTURES SHOULD NOT BE PLACED IN LINE WITH RAMPS. THE LOCATION OF THE RAMP SHOULD TAKE PRECEDENCE OVER THE LOCATION OF THE DRAINAGE STRUCTURE. WHERE EXISTING DRAINAGE STRUCTURES ARE LOCATED IN THE RAMP PATH OF TRAVEL, USE A MANUFACTURER'S ADA COMPLIANT GRATE. OPENINGS SHALL NOT BE GREATER THAN ½". ELONGATED OPENINGS SHALL BE PLACED SO THAT THE LONG DIMENSION IS PERPENDICULAR TO THE DOMINANT DIRECTION OF TRAVEL.

THE TOP OF THE JOINT FILLER FOR ALL RAMP TYPES SHALL BE FLUSH WITH THE ADJACENT CONCRETE.

CROSSWALK AND STOP LINE MARKINGS, IF USED, SHALL BE SO LOCATED AS TO STOP TRAFFIC SHORT OF RAMP CROSSINGS. SPECIFIC DETAILS FOR MARKING APPLICATIONS ARE GIVEN IN THE "MICHIGAN MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES".

FLARED SIDES WITH A SLOPE OF 10% MAXIMUM, MEASURED ALONG THE ROADSIDE CURB LINE, SHALL BE PROVIDED WHERE AN UNOBSTRUCTED CIRCULATION PATH LATERALLY CROSSES THE CURB RAMP. FLARED SIDES ARE NOT REQUIRED WHERE THE RAMP IS BORDERED BY LANDSCAPING, UNPAVED SURFACE OR PERMANENT FIXED OBJECTS. WHERE THEY ARE NOT REQUIRED, FLARED SIDES CAN BE CONSIDERED IN ORDER TO AVOID SHARP CURB RETURNS AT RAMP OPENINGS.

DETECTABLE WARNING PLATES MUST BE INSTALLED USING FABRICATED OR FIELD CUT UNITS CAST AND/OR ANCHORED IN THE PAVEMENT TO RESIST SHIFTING OR HEAVING.

MDOT
Michigan Department of Transportation

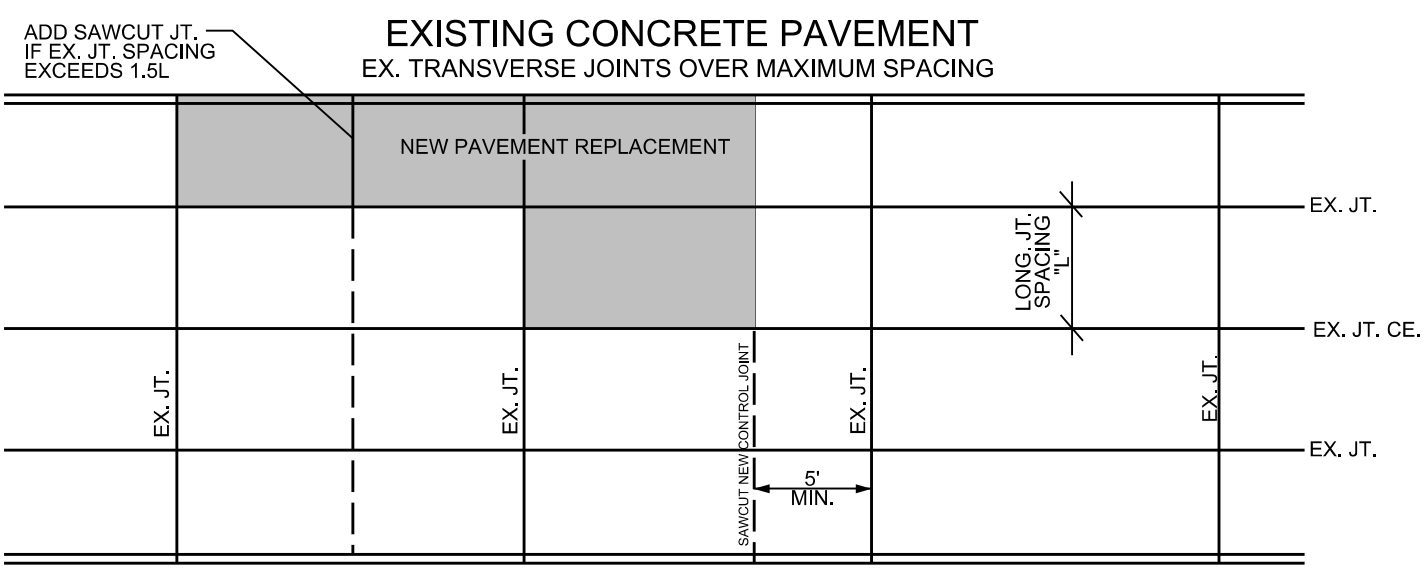
DEPARTMENT DIRECTOR
BRADLEY C. WIEFERICH, PE

STANDARD PLAN FOR
CURB RAMP AND
DETECTABLE WARNING DETAILS

(SPECIAL DETAIL)	11/08/2023	R-28-K	SHEET
FHWA APPROVAL	PLAN DATE		7 OF 7

EXISTING CONCRETE PAVEMENT

EX. TRANSVERSE JOINTS OVER MAXIMUM SPACING

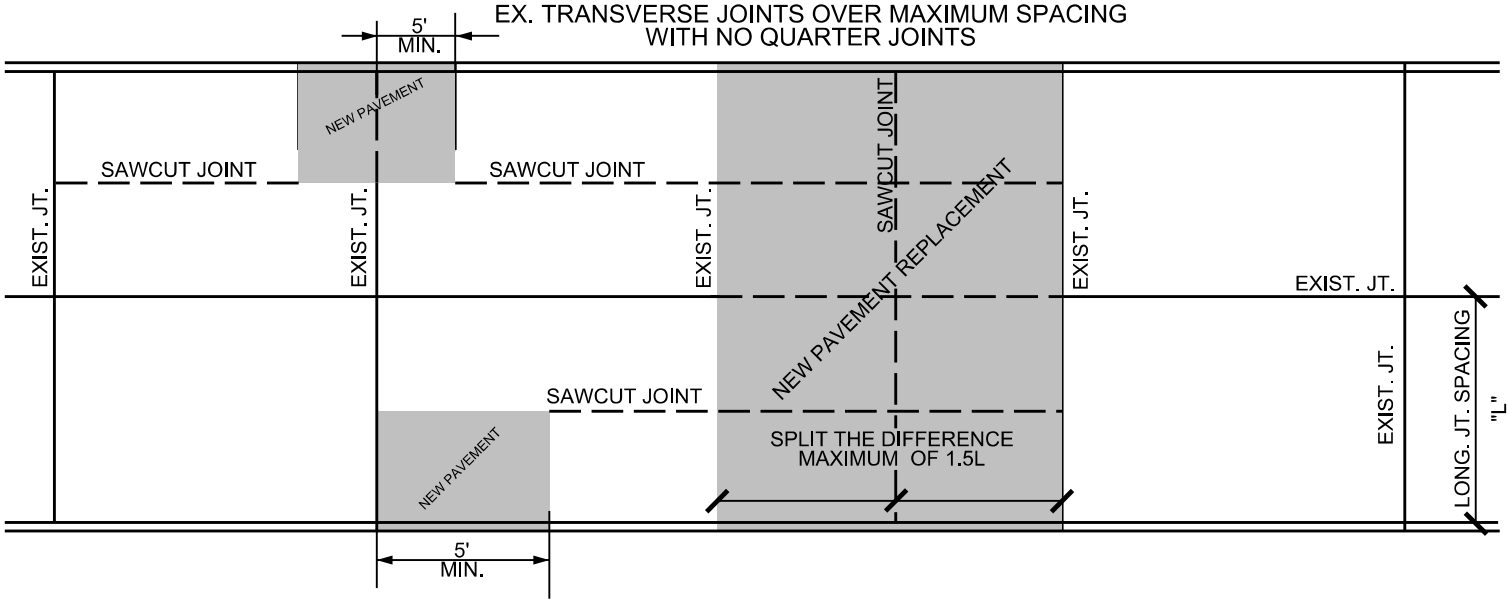


NOTE:

TRANSVERSE JOINT SPACING SHALL BE A MAXIMUM OF 1.5 TIMES THE LONGITUDINAL JOINT SPACING OR AS DIRECTED BY THE ENGINEER.

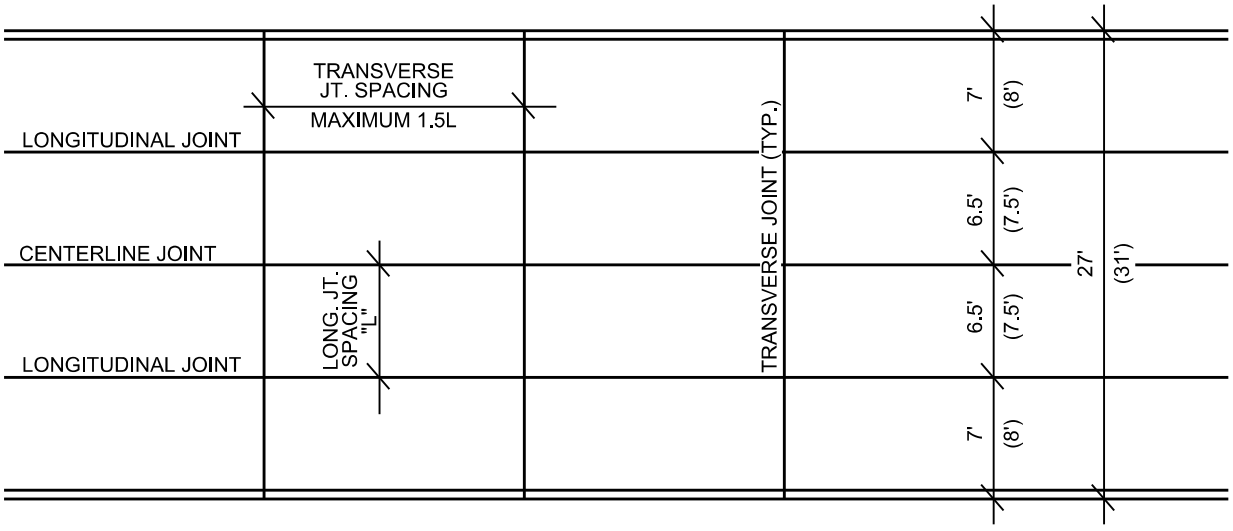
EXISTING CONCRETE PAVEMENT

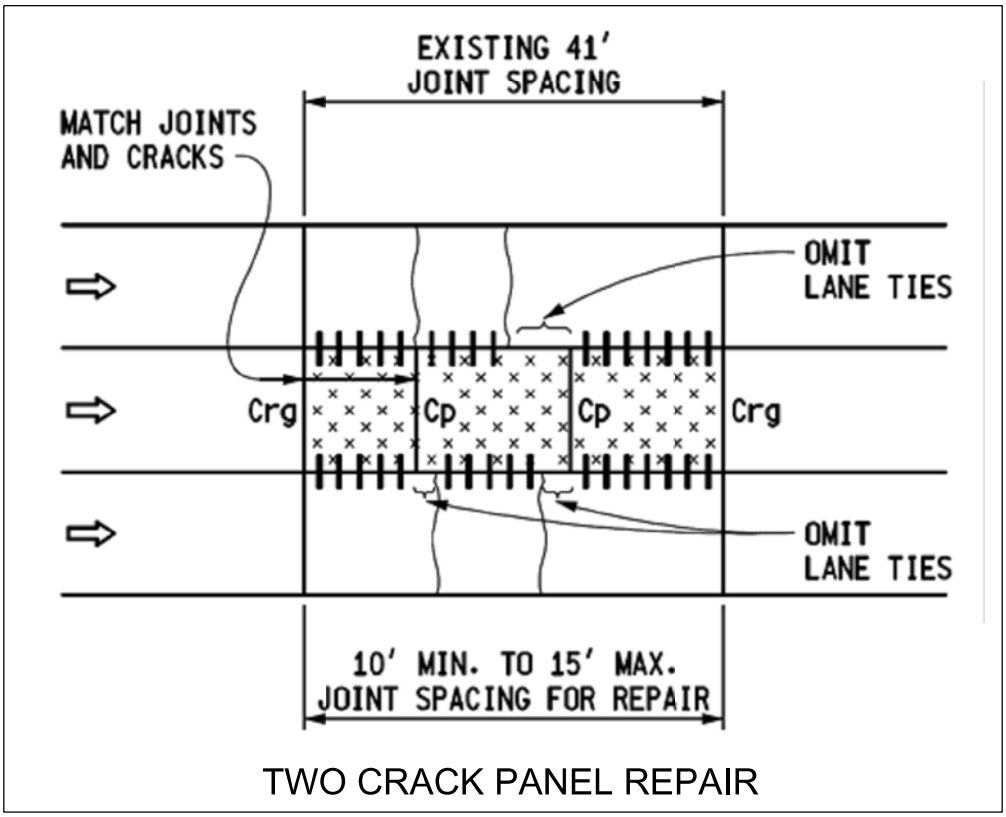
EX. TRANSVERSE JOINTS OVER MAXIMUM SPACING
WITH NO QUARTER JOINTS



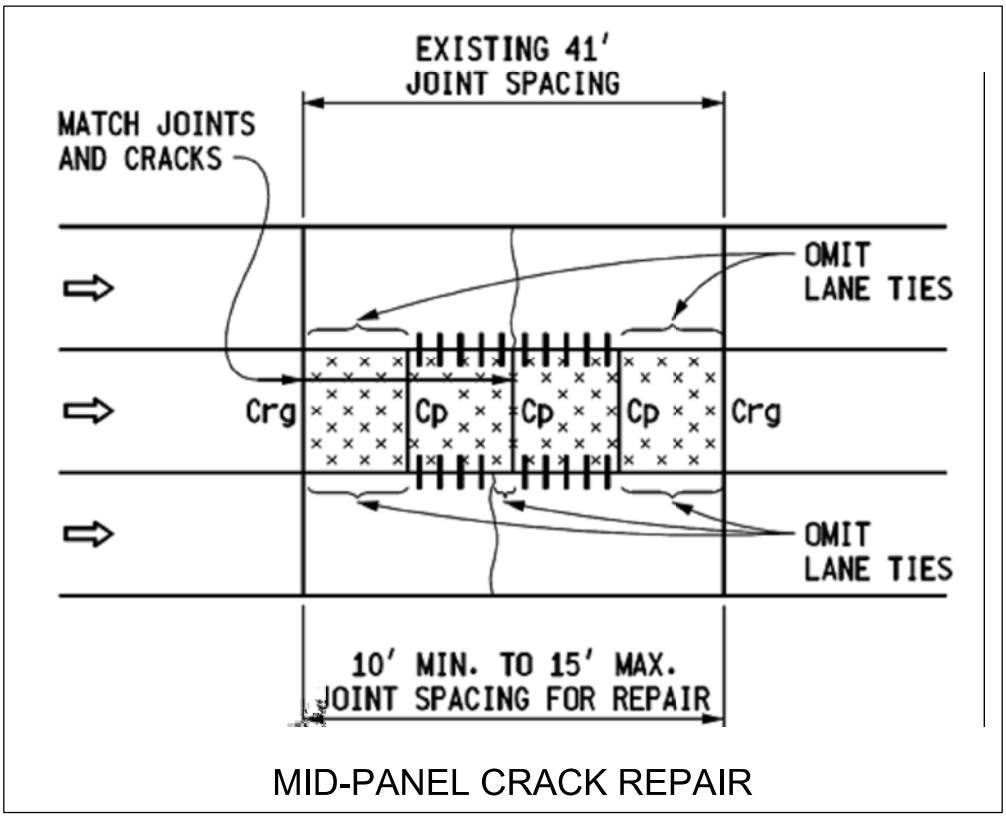
TYPICAL JOINT LAYOUT

NEW CONCRETE PAVEMENT





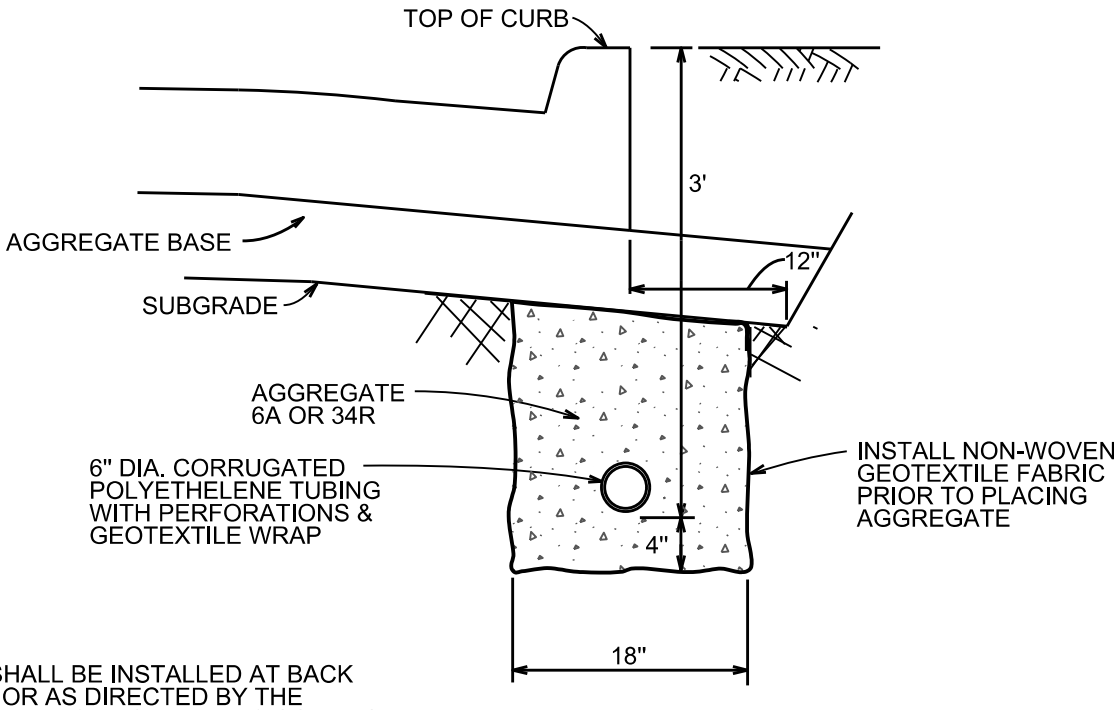
TWO CRACK PANEL REPAIR



MID-PANEL CRACK REPAIR

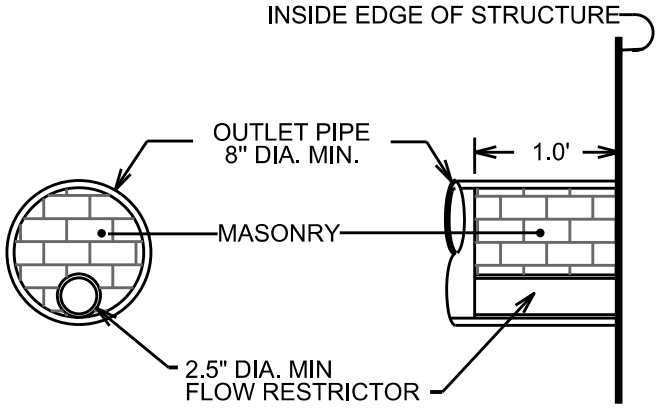
CONCRETE PAVEMENT REPAIR DETAILS

(PER MDOT STANDARD PLAN R-44)



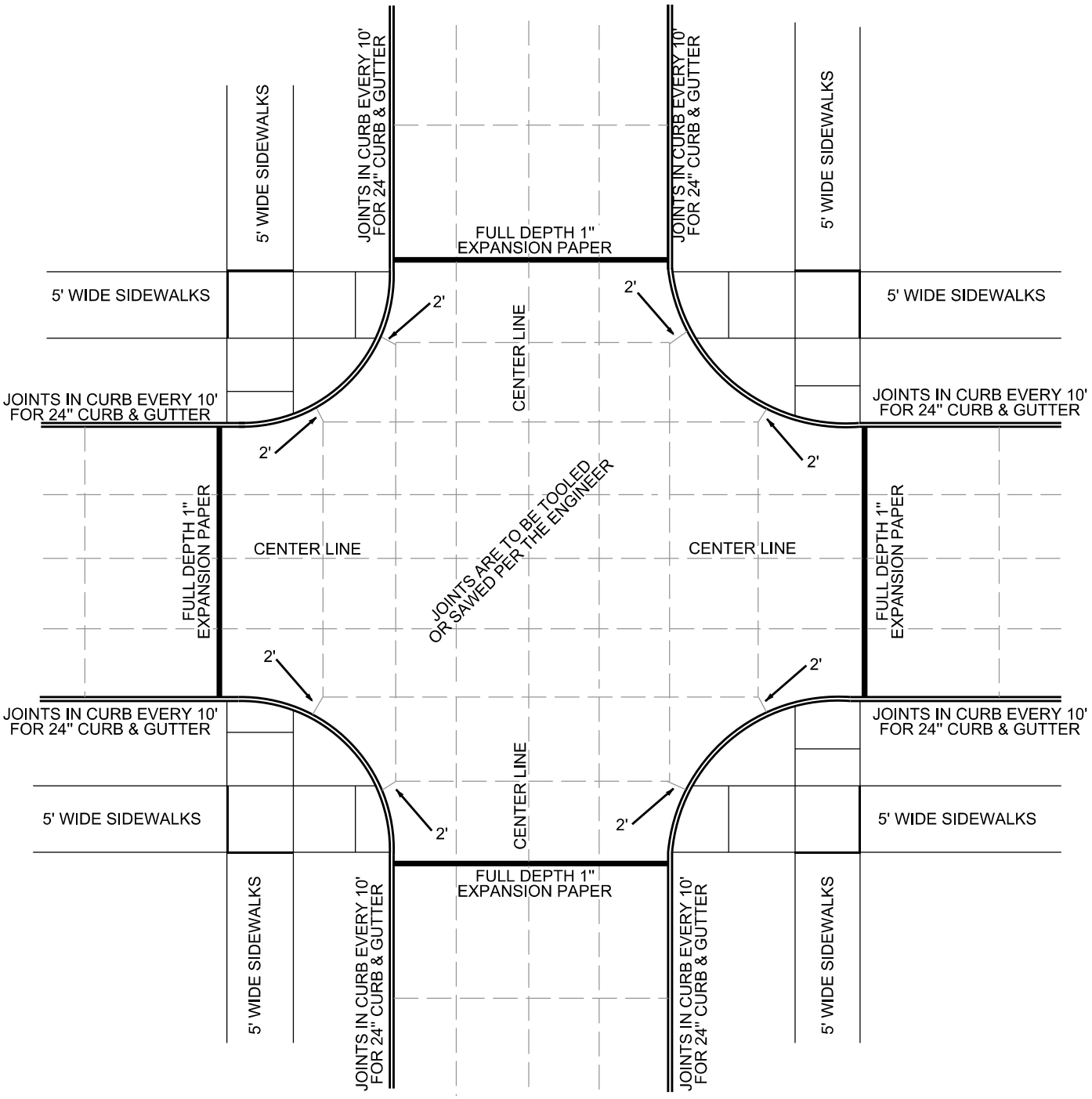
NOTES:
1. UNDERDRAIN SHALL BE INSTALLED AT BACK OF CURB LINE, OR AS DIRECTED BY THE ENGINEER WHEN EXISTING UTILITIES CONFLICT WITH THE UNDERDRAIN TRENCH.
2. UNDERDRAIN SHALL BE REQUIRED IN CLAYEY SOILS OR AS DIRECTED BY THE ENGINEER.

EDGEDRAIN / UNDERDRAIN DETAIL

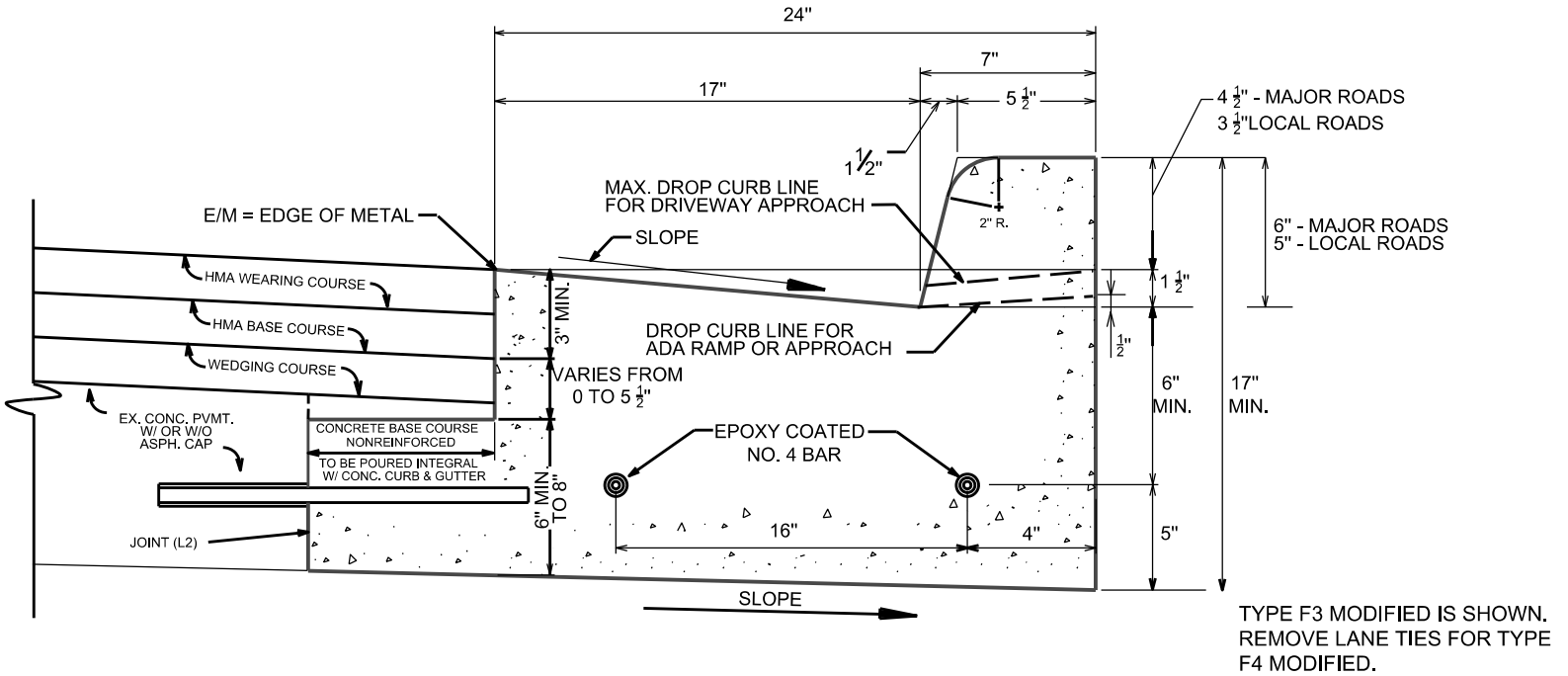


FLOW RESTRICTOR DETAIL

TYPICAL INTERSECTION

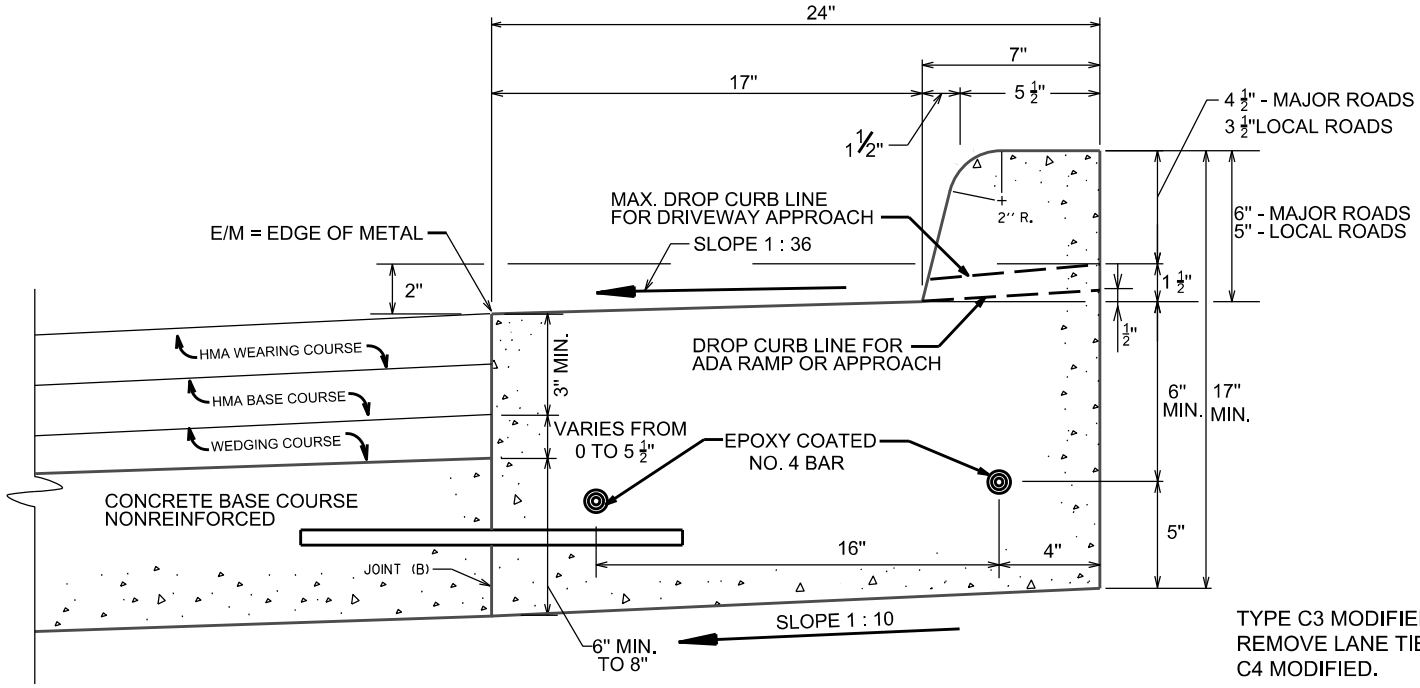


JOINT LAYOUT FOR A COMMON INTERSECTION



TYPE F3 MODIFIED IS SHOWN.
REMOVE LANE TIES FOR TYPE
F4 MODIFIED.

DETAIL F3 / F4 MODIFIED
CONCRETE CURB & GUTTER



TYPE C3 MODIFIED IS SHOWN.
REMOVE LANE TIES FOR TYPE
C4 MODIFIED.

DETAIL C3/C4 MODIFIED
CONCRETE CURB & GUTTER
FOR SPILL OUT CURB AREAS

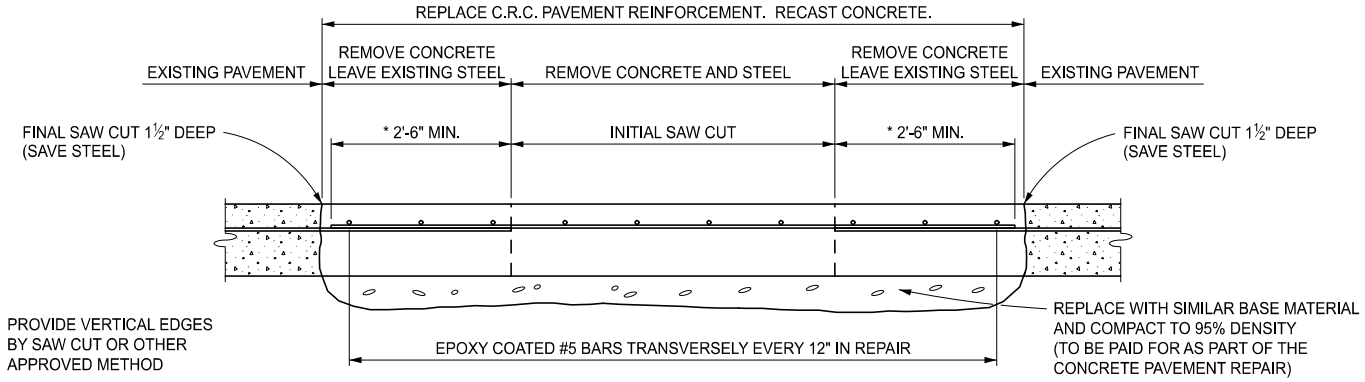
NOTES:

1. PROVIDE 1/8" WIDE BY 2 1/2" DEEP CONTRACTION JOINTS AS SHOWN ON PLAN SHEETS, OR AT INTERVALS NOT TO EXCEED 3 FEET.

2. PROPOSED BUTT JOINT AGAINST EXISTING ASPHALT SHALL BE 18"-24" WIDE AND SHALL BE +/- 3" THICK AT EDGE OF METAL OF NEW CURB.

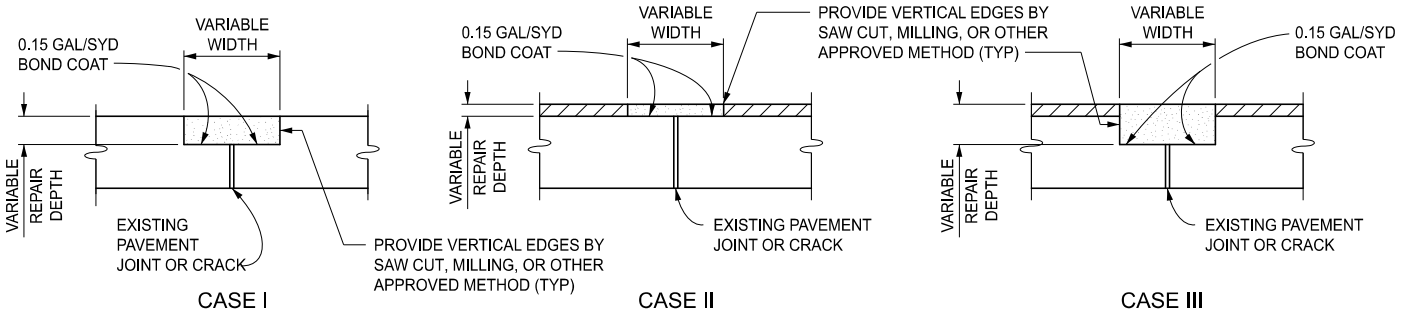
3. REFER TO MDOT DETAIL R-28 (CURRENT VERSION) FOR DROP CURB CONFIGURATION AT ADA COMPLIANT HANDICAP RAMPS.

4. WHERE GUTTER PAN IS CAPPED WITH HMA, THE CURB REVEAL SHALL BE 5" (LOCAL ROADS) OR 6" (MAJOR ROADS).



* NOTE: IF EXISTING REINFORCEMENT LAPS ARE ENCOUNTERED IN THIS AREA, FINAL SAW CUT MUST BE MOVED BACK TO PROVIDE MINIMUM 2'-6" LAP OF PAVEMENT REINFORCEMENT.

REPAIRING CONTINUOUSLY REINFORCED CONCRETE



CASE I

HMA REPAIR OF CONCRETE PAVEMENT

REMOVE LOOSE DETERIORATED CONCRETE. (NOT TO EXCEED PAVEMENT THICKNESS)

CASE II

HMA REPAIR OF CONCRETE PAVEMENT WITH HMA SURFACE

REMOVE HMA OVERLAY TO CONCRETE SURFACE.

CASE III

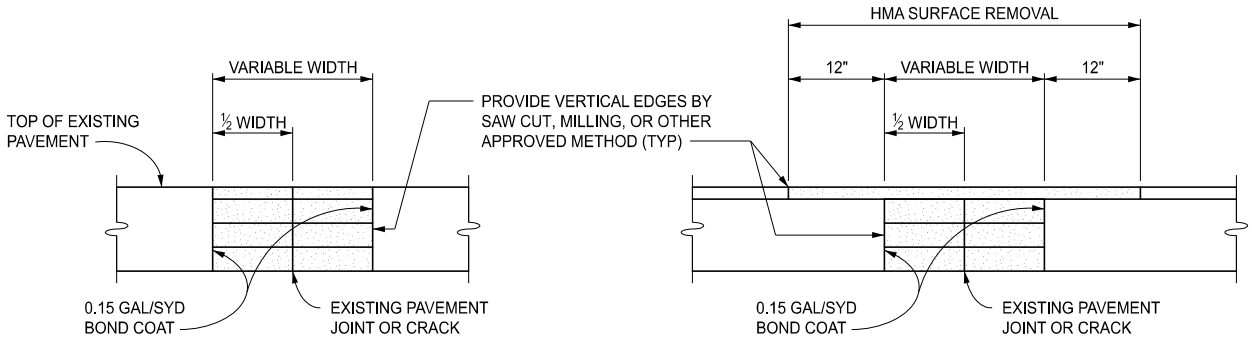
HMA REPAIR OF CONCRETE PAVEMENT WITH HMA SURFACE

REMOVE HMA OVERLAY AND LOOSE DETERIORATED CONCRETE. (NOT TO EXCEED PAVEMENT THICKNESS)

FOR CASES I, II, & III, THE REMOVED MATERIAL SHALL BE REPLACED WITH A HMA TOP COURSE MIXTURE, OR OTHER APPROVED MIXTURE. THE HMA SHALL BE COMPACTED WITH A MACHINE VIBRATOR OR APPROVED ROLLER WITH BASE LIFT THICKNESSES NOT TO EXCEED 3" AND WITH THE TOP LIFT THICKNESS NOT TO EXCEED 2". THE FINAL SURFACE OF THE REPAIR SHALL BE FLUSH WITH THE EXISTING PAVEMENT SURFACE.

SURFACE REPAIR FOR JOINT OR CRACK (TRANSVERSE OR LONGITUDINAL)

DETAIL 7



CASE IV

FULL DEPTH HMA REPAIR OF CONCRETE PAVEMENT

REMOVE THE DETERIORATED CONCRETE FULL DEPTH. COMPACT LOOSE EXISTING BASE. REPLACE AND COMPACT WITH HMA ANY LOST BASE.

CASE V

FULL DEPTH HMA REPAIR OF CONCRETE PAVEMENT WITH HMA SURFACE

REMOVE EXISTING HMA DETERIORATED CONCRETE PAVEMENT FULL DEPTH. COMPACT LOOSE EXISTING BASE. REPLACE AND COMPACT WITH HMA ANY LOST BASE.

FOR CASES IV, & V, THE REMOVED MATERIAL SHALL BE REPLACED WITH A HMA TOP COURSE MIXTURE, OR OTHER APPROVED MIXTURE. THE HMA SHALL BE COMPACTED WITH A MACHINE VIBRATOR OR APPROVED ROLLER WITH BASE LIFT THICKNESSES NOT TO EXCEED 3" AND WITH THE TOP LIFT THICKNESS NOT TO EXCEED 2". THE FINAL SURFACE OF THE REPAIR SHALL BE FLUSH WITH THE EXISTING PAVEMENT SURFACE.

FULL DEPTH REPAIR FOR JOINT OR CRACK (TRANSVERSE OR LONGITUDINAL)

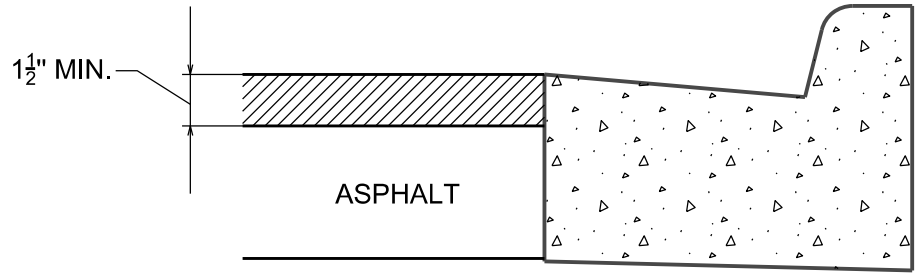
DETAIL 8

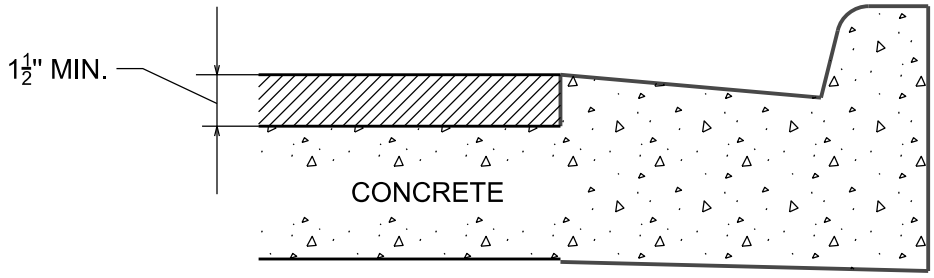
MDOT Michigan Department of Transportation

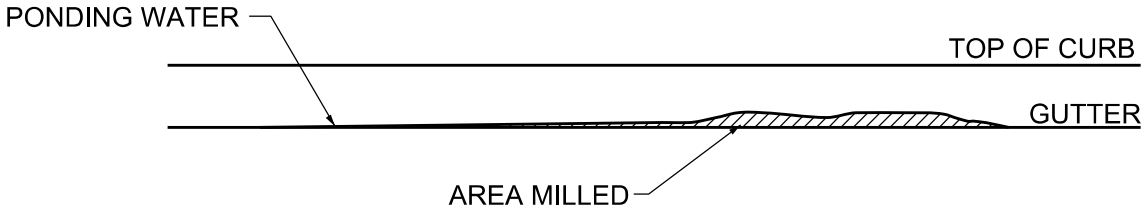
DEPARTMENT DIRECTOR
BRADLEY C. WIEFERICH, PE

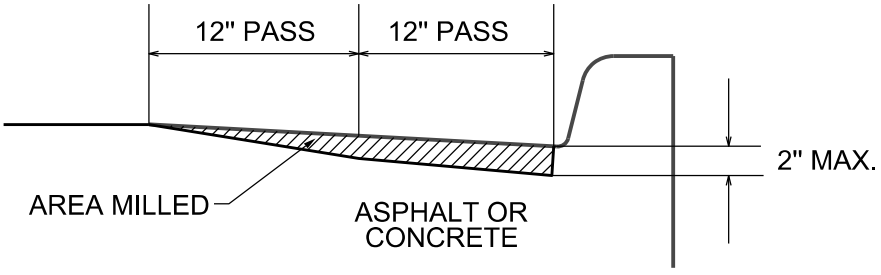
STANDARD PLAN FOR
CONCRETE PAVEMENT REPAIR

(SPECIAL DETAIL) FHWA APPROVAL	09/18/2023 PLAN DATE	R-44-G	SHEET 6 OF 7

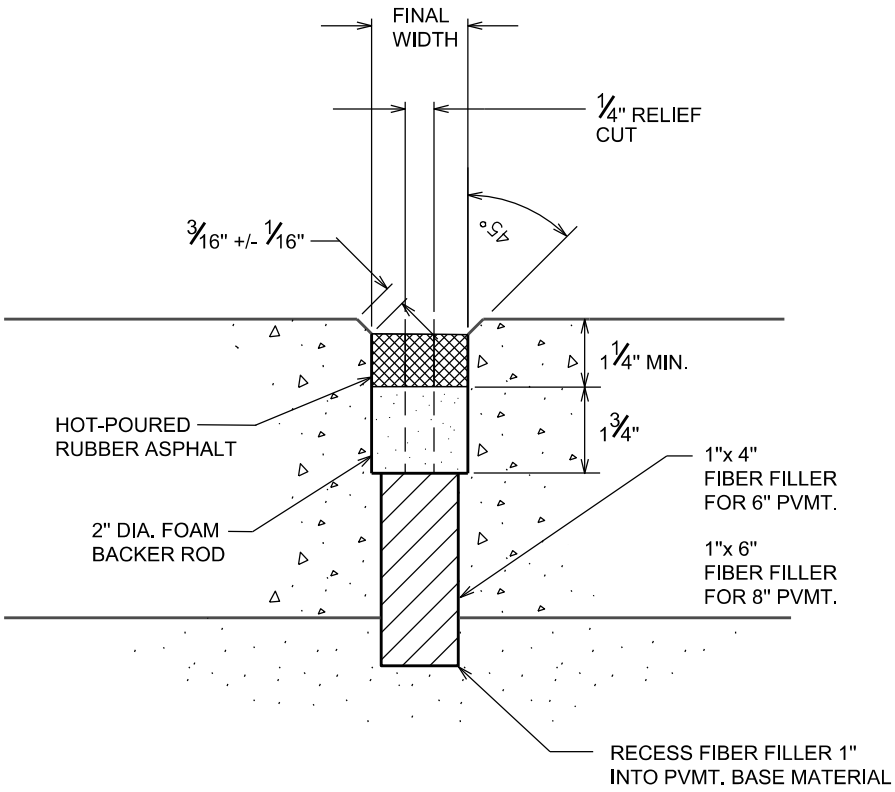








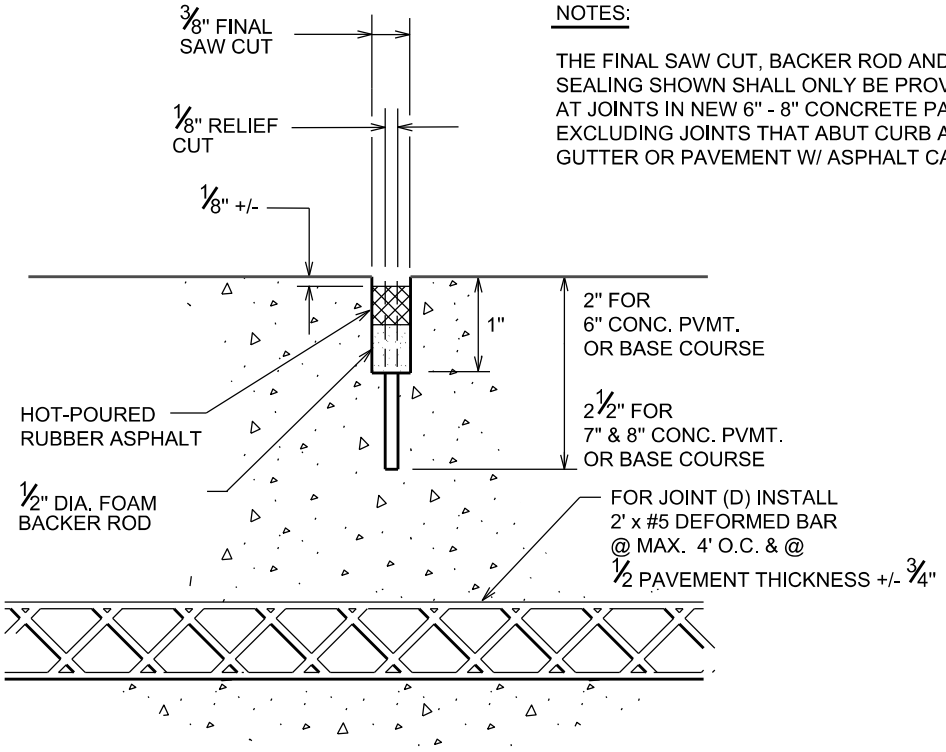
MILLING DETAILS



NOTES:

1. THE FINAL WIDTH OF THE GROOVE SHALL BE 1 1/2" +/- 1/16" PLUS ANY INCREASE OR MINUS ANY DECREASE IN THE WIDTH OF THE RELIEF CUT. THE FINAL SAW CUT SHALL BE TO THE TOP OF THE FIBER FILLER WITH A MINIMUM DEPTH AS SHOWN AND SHALL BE CENTERED OVER THE FIBER FILLER WITH A HORIZONTAL TOLERANCE OF 1/4".
2. THE FINAL SAW CUT, BACKER ROD AND SEALING SHOWN SHALL NOT BE PROVIDED FOR (E3) JOINTS AGAINST CONCRETE CURB & GUTTER SECTIONS OR CONCRETE PVMT. W/ ASPH. CAP. FOR SUCH CASES, THE 1" FIBER FILLER HEIGHT SHALL BE EXTENDED TO THE FINISHED SURFACE OF THE CURB & GUTTER OR CONCRETE PVMT. AFTER COLD-MILLING.

TRANSVERSE EXPANSION JOINT (E3)



NOTES:

THE FINAL SAW CUT, BACKER ROD AND SEALING SHOWN SHALL ONLY BE PROVIDED AT JOINTS IN NEW 6" - 8" CONCRETE PAVEMENT, EXCLUDING JOINTS THAT ABUT CURB AND GUTTER OR PAVEMENT W/ ASPHALT CAP.

LONGITUDINAL LANE JOINT (D)
or
TRANSVERSE PLANE OF WEAKNESS JOINT (DI)

GENERAL SPECIFICATIONS FOR CONSTRUCTION SIGNING AND BARRICADING

1.00 GENERAL

1.01 **LIGHTED ARROW, TYPE A**: Each Lighted Arrow, Type A is to be furnished, maintained, installed, relocated and removed by the Contractor. Payment shall be made for the maximum number of units utilized on each part of the project on any day.

Refer to Section 812 of the MDOT Standard Specifications for Construction and current edition of the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.). The Type A panel shall be solar powered, nominal 48 inches x 96 inches, furnished flat black with lamps having an amber lens. A photoelectrically controlled circuit shall be provided to dim the lighted arrow lamps for night use. The lamps shall flash synchronously at the rate of 25 to 35 flashes per minute. The "on time" shall comprise 40 to 60 percent of each cycle. The arrow panel shall have the capability of the following modes: Left Arrow, Right Arrow, Double-Headed Arrow, and Caution. The Caution mode shall consist of four (4) or more lamps, arranged in a pattern which will not indicate a direction.

No claim for additional compensation will be allowed for units that are stolen, damaged by traffic or vandalized. Placement shall be as directed by the Engineer and per the requirements of the M.M.U.T.C.D.

1.02 **BARRICADE TYPE II, PLASTIC DRUM or CONES**: Barricades paid for this item of work shall be Type II. Payment shall be per barricade; this shall include furnishing, maintaining, installation, relocation, and removal; and shall be measured for the maximum number of units in place on each part of the project on any day. Traffic cones in accordance with Section 812 of the MDOT Standard Specifications for Construction may be used, limited to daytime hours only. Do not mix drums and cones within a traffic control signing sequence.

Refer to Section 812 of the MDOT Standard Specifications for Construction and the current edition of the M.M.U.T.C.D. Type II barricades shall be minimum 28 inch diameter plastic drums coated with reflectorized material or "snatch" cones. Weights, sand bags or base tire rings shall be provided as supplemental weight to achieve stability.

No claim for additional compensation will be allowed for barricades that are stolen, damaged by traffic or vandalized. Placement shall be as directed by the Engineer and per the requirements of the M.M.U.T.C.D.

1.03 **BARRICADE TYPE III**: Barricades paid for this item of work shall be Type III. Payment shall be per barricade; this shall include furnishing, maintaining, installation, relocation, and removal; and shall be measured for the maximum number of units in place on each part of the project on any day.

All Type III barricades shall be 8 foot wide - minimum sections furnished. Construction signing to be affixed to Type III barricades shall be paid as each. No claim for additional compensation will be allowed for barricades that are stolen, damaged by traffic, or vandalized. Type III barricades shall be placed at locations indicated on the construction signing and traffic control plan and as necessary to assure conformance with the current edition of the M.M.U.T.C.D.

1.04 **SIGN, TYPE B TEMPORARY**: Refer to Sections 812 and 922 of the MDOT Standard

Specifications for Construction and the current edition of the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.). This item of work consists of providing and maintaining MDOT Type B temporary signing for advance signing, detour signing, and for the protection and maintenance of traffic through and around the Construction Influence Area. The quantity and types of signing to be provided shall be per the construction signing and traffic control plan and as may be stipulated by M.M.U.T.C.D., City, and Road Commission for Oakland County requirements.

The signing shall include temporary steel posts and hardware, or portable supports. Posts for signing placed outside of hard surfaces shall be power driven into the ground and removed upon completion. Within hard surfaces, a minimum of one (1) sand bag shall be placed on each leg of the portable support to achieve stability.

All advance warning (W) signs and advance guide (G) signs may require to be furnished with a minimum of one (1) 3M Company No. 3484 Fluorescent Red Orange flag (or approved equal) during hours of daylight. All W and G signs shall be lighted with two (2) Type A warning flashers during non-daylight hours (a half hour after sunset to a half hour before sunrise).

The Contractor shall relocate or remove signing, as determined by the Engineer. The Contractor shall place an opaque covering over any signing which has a legend, which is not applicable for any period of time.

Prior to commencing construction operations, W21-1 (ROAD WORK AHEAD) signs shall be placed in advance of the work along the street to be worked on. Also, R11-2 signs (ROAD CLOSED) and R11-4 signs (ROAD CLOSED TO THRU TRAFFIC) may be required as directed by the Engineer.

Payment shall be by the square foot furnished or as addressed in project specifications, and shall include maintaining, installing, relocation, and removal. No claim for additional compensation will be allowed for temporary signs that are stolen, damaged by traffic, or vandalized.

This item of work does not include temporary no parking signs, hand-held paddle signs for flaggers, or any permanent signing work. Refer to the Special Instructions to Bidders for no parking sign and traffic regulator personnel (flagger) requirements. The City shall have the option of removing permanent signs and supports themselves or leaving them to be removed by the Contractor. All replacement of permanent signing will be performed by the City.

In the event that the City has not removed permanent signs and supports when the Contractor enters a work area, the Contractor shall remove the signs and supports in such a way as to avoid damage to either and shall carefully store them at a location outside the work area as directed by the Engineer until the material is picked up by the City.

2.00 PAVEMENT MARKINGS

2.01 REMOVING PAVEMENT MARKING: Refer to Sections 812 and 922 of the MDOT Standard Specifications for Construction and the current edition of the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.). Removal of legends, symbols, arrows, crosswalks, and stop bars will be paid as Removing Pavement Marking.

Removal of longitudinal markings will be paid for as Removing Pavement Marking, Longitudinal. Skips in dashed lines are not included in the measurement. Removal of pavement markings 5 inches or less in width will be paid for at the bid unit price. Removal of pavement markings more than 5 inches but less than 10 inches in width will be paid for at 2 times the bid unit price. Removal of pavement markings 10 inches or more in width will be paid for at 3 times the bid unit price.

2.02 **TEMPORARY PAVEMENT MARKING, TYPE R OR NR, 4" YELLOW OR WHITE**: Refer to Section 812 of the MDOT Standard Specifications for Construction and the current edition of the M.M.U.T.C.D. Temporary pavement markings shall have a nominal width of 4 inches and shall be either yellow or white in accordance with the M.M.U.T.C.D. Temporary markings shall be placed as directed by the Engineer and may include a 2-foot, 4-foot or 12.5-foot dashed pavement marking line, or solid pavement marking line.

Type R temporary pavement markings shall be tape conforming to Subsection 922.06 of the 2020 MDOT Standard Specifications for Construction. Type R markings shall be removable and shall be placed on existing or proposed pavement surfaces at locations that do not coincide with permanent pavement markings. All Type R markings shall be removed when directed by the Engineer.

Payment shall be per linear foot of temporary pavement marking applied or as addressed in a project specification.

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GENERAL SPECIFICATIONS FOR RESTORATION

1.00 SPRINKLER SYSTEMS

1.01 RELOCATE OR REPLACE LAWN IRRIGATION HEADS: This item of work shall consist of all work required to relocate or replace lawn irrigation heads within the road right-of-way or private property when directed by the Engineer. Irrigation heads that are damaged by the Contractor shall be replaced in kind including any fittings, clamps, nipples, drains, protective covering, etc. Heads shall be relocated as directed by the Engineer. The Contractor shall adjust the spray pattern of each head that is relocated or replaced. Payment shall be made for each head relocated or replaced.

1.02 RELOCATE OR REPLACE LAWN IRRIGATION PIPING: This item of work shall consist of all work necessary to relocate or replace lawn irrigation piping within road right-of-way or private property when directed by the Engineer. Irrigation piping that is damaged by the Contractor shall be replaced in kind including any fittings, clamps, drains, valves, etc. Piping shall be relocated as directed by the Engineer. The abutting property owner shall flush and test the relocated piping and any necessary repairs shall be made by the Contractor before payment by the City. Payment shall be made per linear foot of piping relocated or replaced.

2.00 TREES

2.01 TREE REMOVAL INCLUDING STUMP: At locations indicated on the plans or when directed by the Engineer, trees adjacent to the work shall be removed including the stump. Refer to Section 202 of the MDOT Standard Specifications for Construction. In addition, the trees, trunks, and limbs over 8 inches in diameter shall be trimmed and cut into lengths less than eight (8) feet and piled outside of the right-of-way for use by the abutting property owner if requested to do so by the Engineer. The remaining brush shall be disposed of by the Contractor at a recognized landfill. If the property owner does not desire the timber, the Contractor shall be responsible for hauling away and disposing of the removed trees at a recognized landfill.

Tree removal shall be paid at the contract unit price for each tree removed including the stump. The stump shall be removed to a depth of one (1) foot below ground surface. Where removal of the stump may result in damage to existing utilities or pavements, the stump shall be removed by chipping. Payment shall be made for each tree removal as defined by caliper in project specifications.

2.02 INSTALL ORNAMENTAL TREE: This item of work consists of furnishing and planting a specified caliper tree at the locations indicated on the plans or as directed by the Engineer, and in conformance with any details which may be shown on the plans.

Planting materials shall be as specified in Section 815 of the MDOT Standard Specifications for Construction except for the following revisions and additions.

Trees shall have normal well developed branches and vigorous fibrous root systems and shall conform to the specifications of the latest edition of American Standard for Nursery Stock sponsored by the American Association of Nurserymen, Inc.

Trees shall be healthy, vigorous and free from defects; decay; disfiguring roots; sun-scale injuries; abrasions on the bark; diseases; insect pests, their eggs or larvae. Trees shall be hardy under climatic conditions similar to those in the locality of the project and shall be nursery grown.

The following list of trees is acceptable for installation in the right-of-way.

Ginkgo	-	*(Ginkgo biloba)*
Little Leaf Linden	-	*(Tilia cordata)*
Sycamore	-	*(Platanus occidentalis)*
Honey Locust	-	*(Gleditsia triacanthos)*
Sawtooth Oak	-	*(Quercus acutissima)*
Swamp White Oak	-	*(Quercus bicolor)*
Red Oak	-	*(Quercus rubra)*
Hackberry	-	*(Ce/tis occidentalis)*
Armstrong Red Maple	-	*(Acer rubrum)*
Autumn Blaze Maple	-	*(Acer freemanii)*
Norway Maple	-	*(Acer platanoides)*
Sugar Maple	-	*(Acer saccharum)*
Zelkova	-	*(Zelkova serrata)*
Frontier™ Hybrid Elm	-	*(Ulmus carpinifolia x Ulmus parvifolia)*
Triumph™ Hybrid Elm	-	*(Ulmus 'Morton Glossy')*
Accolade™ Hybrid Elm	-	*(Ulmus japonica x Ulmus wilsoniana)*

Construction methods shall be as specified in Sections 815 of the MDOT Standard Specifications for Construction except for the following revisions and additions.

Trees shall be handled at all times in accordance with the best horticultural practices so that the roots or balls are adequately protected from the sun and drying winds. No tree shall be bound with rope or wire in a manner that would damage the bark, break the branches, or destroy its natural shape.

Trees shall be balled and burlapped trees dug with a firm, natural ball of earth of sufficient diameter and depth to encompass the fibrous and feeding root systems necessary for full recovery of the tree. Balls shall be securely wrapped with burlap and bound with cord. All trees shall be delivered in closed vehicles or in open vehicles with the entire load properly covered, while in transit for protection from drying winds.

The diameter of all planting pits shall be at least one foot greater in diameter than the diameter of the ball. The depth of pits shall be enough to accommodate the ball. Earth in the bottom of the pits shall be loosened by spading or other approved means to a depth of 4 inches. Care shall be taken in machine or hand-digging so as to avoid damage to possible existing utilities, conduits, and irrigation piping located close by.

No tree shall be planted if the ball is cracked or broken. No tree balled with rot-proof material will be accepted. Wire mesh baskets holding burlap in place **shall** be removed prior to planting. Mulching shall be as indicated in the detail as shown on the plans.

The completed work of this item will be measured in place by unit and by the methods specified in the current ANSI Specification Z60.1. The contract unit price will be payment in full for furnishing, excavating, pruning, planting, and wrapping the trees. All trees planted shall be guaranteed to grow for a period of one (1) year.

The Engineer will inspect the trees during the final inspection for the Contract to determine if any trees are unacceptable. Unacceptable trees are defined as being dead, unhealthy, or otherwise unsatisfactory at the time of final inspection, or trees that were not planted in conformance with the specifications.

The Contractor shall remove and replace any unacceptable trees identified by the Engineer at no additional cost to the Contract. Replacement trees shall be "puddled" or watered-in at time of planting and mulch shall be replaced.

3.00 **VOLCANIC ROCK SURFACE / DECORATIVE STONE**: This item of work consists of furnishing and installing volcanic rock / decorative stone as a ground cover at locations indicated on the plans or as directed by the Engineer. The work includes any excavation, grading, and disposal of excavated materials for areas that are to receive the volcanic rock / or decorative stone.

The material shall be spread uniformly to a thickness of 3 inches or as directed by the Engineer, and the completed work shall match adjacent grades. The volcanic rock (pumice) or stone to be furnished and installed shall be a clean, uniformly graded material having 3/4 to 2 inches of particle size.

The completed work of this item will be measured by volume in cubic yards, loose measure or as specified in project specifications. The contract unit price will be payment in full for furnishing and installing the materials.

4.00 **CHEMICAL WEED SPRAY & WEED REMOVAL**: The work of this item consists of furnishing and applying chemical weed killer to earth beds as directed by the Engineer, including removal and off-site disposal of the resulting dead vegetation. The chemical weed killer shall be labeled and applied in accordance with the Michigan Pesticide Control Act (P.A. 171 of 1976, as amended).

The chemical weed killer shall be applied no less than seven (7) days prior to topsoil installation. The application rate shall be 1/2 gallon per acre minimum, and dilution with water shall be per manufacturer recommendations. The Contractor shall remove the resulting dead vegetation directly prior to topsoil installation.

The chemical weed killer shall be applied by a person that has a Commercial Pesticide Applicator Certification issued by the Michigan Department of Agriculture.

The chemical weed killer shall be a manufactured non-volatile, broad spectrum foliage translocated herbicide to be approved by the Engineer containing Isopropylamine salt of N-(Phosphonomethyl) Glycine.

The complete work of this item will be measured by volume in gallons of chemical weed killer in the concentrated state (prior to being mixed with water). The contract unit price will be payment in full for furnishing all labor, materials, and equipment for applying the chemical weed spray, including removal and disposal of dead vegetation.

5.00 LAWN RESTORATION

5.01 **TOPSOIL (LOOSE MEASURE)**: This item shall consist of furnishing and grading approved screened topsoil for areas to be sodded or seeded. The material and work shall conform to MDOT Standard Specifications for Construction, Section 816 except that topsoil shall be spread, graded and compacted with a plate compactor or lawn roller to a depth of not less than 2 inches, but in no case greater than 3 inches. Payment shall be by the cubic yard (loose measure). Load tickets from the supplier shall indicate cubic yards, and a copy must be furnished to the City at the time of delivery.

This item of work includes grading and compacting of earth beds upon which the topsoil is to be placed and cutting, removal, and disposal of the existing turf. The limits of areas to receive topsoil shall be marked in the field by the Engineer. Where topsoil is to be placed against existing turf, a vertical edge shall be cut through the turf using an approved sod cutter. Existing turf shall be removed from the earth bed to receive topsoil, and the turf shall be hauled away by the Contractor within 24 hours of removal.

5.02 **CLASS A SEEDING AND MULCH BLANKET, INCLUDING WATERING**: This item shall consist of furnishing and installing seeding and mulch blanket as specified in Section 815 and 816 of the MDOT Standard Specifications for Construction at locations directed by the Engineer.

Provide, install, and anchor mulch blankets. Place mulch blankets within one calendar day after seeding. Secure with net anchors. Overlap blanket edges by 2 inches and shingle lap blanket ends with a 6-inch overlap. Place net anchors along joint edges and blanket centerlines no greater than 2 feet apart.

This item of work includes thoroughly watering all seeded areas at such times and in amounts to **establish growth** of lawn areas for a period of 90 days after the seed is installed or reinstalled. Seed placed prior to October 1st shall exhibit growth prior to becoming dormant for the winter. Seed placed after October 1st shall establish growth by June 1st of the following year.

The Contractor shall provide a watering truck acceptable to the Engineer. Water for lawn watering will be provided to the Contractor by the City at hydrant locations specified by the Engineer. The Contractor shall notify the Engineer to coordinate with City personnel for witnessing hydrant operation when filling the truck. All trucks being filled shall have a minimum 6-inch "air gap" between the fill hose and the tank opening or use an approved back-flow prevention device.

Measurement and payment for this item of work shall be by square yard (SY).

5.03 **HYDROSEEDING INCLUDING FERTILIZER AND MULCH**: This item of work shall consist of hydroseeding and mulching areas adjacent to the back of curb for major roads

or as directed by the Engineer. All areas to receive hydroseeding shall be free of weeds. If directed by the Engineer, the Contractor shall apply a chemical weed killer no less than seven (7) days prior to topsoil installation as described under section 4.00.

The seed, mulch, fertilizer, and water mix shall be evenly applied to properly prepared topsoil surfaces. The seed shall be applied at a rate of 250 pounds per acre and shall have the following composition:

30% .....Fults Puccinellia
30% .....Dawson Red Fescue
30% .....Park Kentucky Blue
10% .....Pennfine Perennial Rye, minimum purity 97%

The mulch shall be “Fiber-Green”, “Conweb”, or approved equal and shall be applied at a rate recommended by the manufacturer.

The chemical fertilizer shall have a 12% nitrogen, 12% phosphorus, and 12% potassium (“12-12-12”) and shall be applied at a rate of 240 pounds per acre. Payment for this Item shall be by the square yard measured in place.

Obtain the Engineer’s approval for proposed seed mix. Obtain the inspector’s approval of topsoil prior to placement. When specified, apply the fertilizer with or before the sowing of the seeds. Sow and re-sow the seed as necessary to provide uniform coverage (minimum of 220 pounds per acre and greater than 2 seeds per square inch). Compact the seed into the top 1/2 inch of topsoil. When specified, install the mulch within one calendar day after seeding. The end product shall be well established, weed free, growing, vigorous and contains the species required in the seeding mix.

5.04 **CLASS A SODDING, INCLUDING WATERING**: This item shall consist of furnishing and installing Class A sod in accordance with MDOT Standard Specifications for Construction, Sections 815 and 816. The furnished sod shall be a uniform thickness of not less than one (1) inch and an area of not less than 1/2 square yard. Class A sodding will be paid for at the contract unit price per square yard measured in place. Areas adjacent to the back of curb for local side streets, and all private property, shall receive Class A sod unless otherwise indicated on the plans.

This item of work includes thoroughly watering all sod areas at such times and in amounts to establish growth of lawn areas for a period of 90 days after the sod is installed or reinstalled. Sod placed prior to October 1st shall exhibit growth prior to becoming dormant for the winter. Sod placed after October 1st shall establish growth by June 1st of the following year.

The Contractor shall provide a watering truck acceptable to the Engineer. Water for lawn watering will be provided to the Contractor by the City at hydrant locations specified by the Engineer. The Contractor shall notify the Engineer to coordinate with City personnel for witnessing hydrant operation when filling the truck. All trucks being filled shall have a minimum 6-inch "air gap" between the fill hose and the tank opening, or use an approved back-flow prevention device.

6.00 **EXCAVATION**

6.01 **REMOVAL & DISPOSAL OF CONTAMINATED EXCAVATED MATERIAL**: This item consists of removal and disposal of both Type 1 and Type 2 contaminated material if encountered during excavation. The City will be responsible for testing any suspected hazardous contaminated material. This item of work shall be paid per cubic yard, loose measure, which is removed and disposed of at a Type 1 or Type 2 approved landfill.

The contract unit price for this item shall include the cost of interruption to normal construction procedures, temporary stockpiling on plastic sheeting, placing and maintaining plastic sheeting over the stockpile, removal and disposal as directed by the City, and all related work and measures that may be required by law. Based on field screening and laboratory analysis by the City, the Contractor will be advised by the City as to the required method of disposal.

Under no circumstances shall this item include removal and disposal of contaminated material caused by or brought to the site by the Contractor.

6.02 **EARTH EXCAVATION AND GRADING REMOVAL OF EXCESS MATERIAL**: This item consists of removal and disposal of excavated material generated during grading for topsoil / sod and sloping along and away from new sidewalk grade ramp installations. This item of work shall cover all aspects of this item including grading, removing material, temporary stockpiling, and disposal. The thickness of material graded and removed shall be from 1 inch to 1 foot in depth, removal and hauling away of the excess material is the Contractor's responsibility. Payment shall be as specified in the Form of Proposal.

7.00 **SHREDDED BARK MULCH (LOOSE MEASURE)**: This item of work consists of furnishing and installing a 4" thick blanket of shredded bark mulch material at landscape areas, planting beds, or at existing tree locations disturbed by the construction or as directed by the Engineer. The work for this item shall be in accordance with Subsection 917.13 of the 2020 MDOT Standard Specifications for Construction except as specified herein.

Shredded bark mulch shall consist of tree bark, which has been stripped from saw logs by means of a de-barking machine. The type and color of shredded bark mulch around existing plantings and planting beds shall match the existing type and color of mulch and shall be approved by the Engineer before it is installed. The shredded bark mulch shall be manually placed to a depth of 4" and shall include replacement or installation of new plastic edging where removed.

The completed work of this item will be measured in place by volume in cubic yards, loose measure, of shredded bark mulch placed. The contract unit price will be payment in full for furnishing and installing the shredded bark mulch blanket including any plastic edging.

8.00 **TREATED LANDSCAPE TIMBERS**: This item of work consists of furnishing, cutting, and installing new preservative-treated landscape timbers at locations where public sidewalk is replaced if directed by the Engineer. The timbers shall be installed directly adjacent to the public sidewalk. When the new timbers are an extension of existing timbers, the work shall include cutting, removal, and off-site disposal of portions of the existing timbers when directed by the Engineer. When the new timbers are installed in

tiers, the work shall include drilling holes, and furnishing and installing steel anchor pins (dowels).

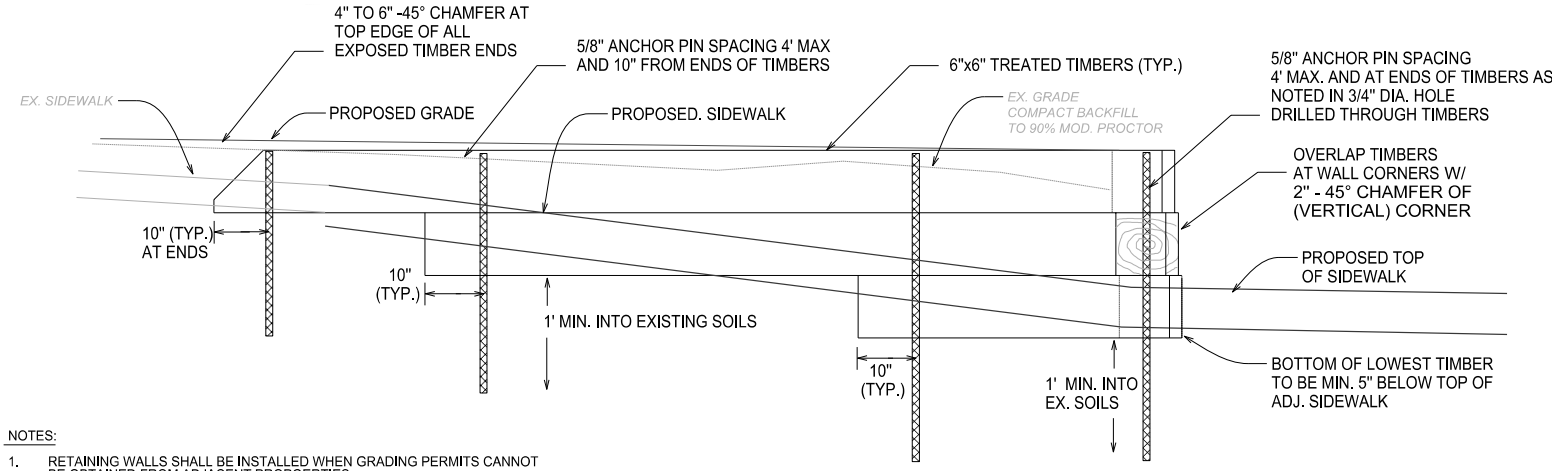
The landscape timbers shall be cut as necessary and installed on a compacted base adjacent to the sidewalk. For landscape timbers installed in tiers, 45° beveled ends shall be cut and 3/4 inch diameter holes shall be drilled for steel anchor pins along the centerline of the tier being installed. Holes shall be drilled 10 inches from the end of each timber so that a minimum of two (2) anchor pins are installed for each timber. Holes shall be drilled to extend 4 inches into the adjacent tier below. Each tier shall be recessed 1/2" towards the embankment with respect to the adjacent tier below, and the joints between timbers along each tier shall be staggered with respect to the joints in the adjacent tier below.

Landscape timbers shall meet the requirements specified in Section 912 of the MDOT Standard Specifications for Construction, except as otherwise specified herein. Landscape timbers to be furnished shall be preservative-treated No. 2 Grade timbers maximum 8 feet in length.

The landscape timbers furnished shall be nominal 6" x 6" size timbers. When the timbers to be installed are an extension of existing timbers, the nominal size of the new timbers shall equal the nominal size of the existing timbers.

Where landscape timbers are to be installed in tiers, 8 inches long x 5/8" diameter steel anchor pins (dowels) shall be furnished per Subsection 908.10 of the 2020 MDOT Standard Specifications for Construction.

The completed work of this item will be measured in place by length in feet of new landscape timber installed along each tier. The contract unit price will be payment in full for furnishing, cutting, and installing landscape timbers including steel anchors.



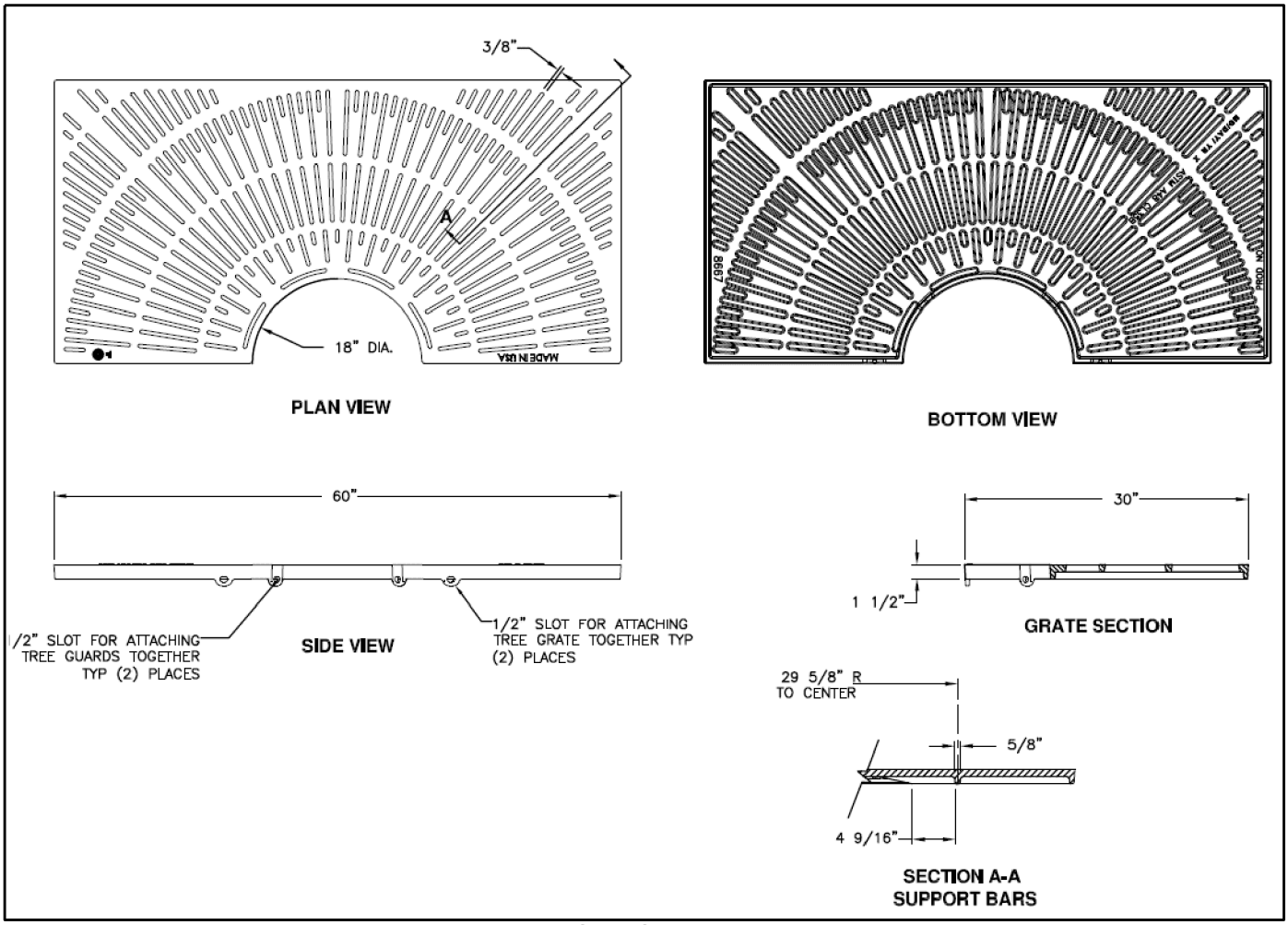
NOTES:

1. RETAINING WALLS SHALL BE INSTALLED WHEN GRADING PERMITS CANNOT BE OBTAINED FROM ADJACENT PROPOERTIES,
2. THIS DETAIL IS APPLICABLE FOR RETAINING EXISTING SOILS ON PRIVATE PROPERTY ADJACENT TO PUBLIC SIDEWALK. EDGE OF RETAINING WALL SHALL BE SET ADJACENT TO THE PRIVATE PROPERTY SIDE EDGE OF THE PUBLIC SIDEWALK. RIGHT OF WAY AREAS SHALL BE GRADED FLUSH TO FINAL SIDEWALK GRADES. RAMP AREAS SHALL BE GRADED FLUSH TO THE TOP OF ROLLED SIDEWALK EDGE.
3. THIS DETAIL IS APPLICABLE FOR WALLS 10" TO 18" IN HEIGHT ABOVE SIDEWALK.
4. EACH TIER SHALL BE RECESSED 1/2" INCH TOWARDS THE EMBANKMENT WITH RESPECT TO THE TIER BELOW.
5. JOINTS BETWEEN ADJACENT TIMBERS SHALL BE STAGGERED WITH RESPECT TO THE TIMBER TIERS ABOVE OR BELOW.

TYPICAL TIMBER RETAINING WALL DETAIL AT SIDEWALK INTERSECTION

NO SCALE

TREE GRATE & FRAME



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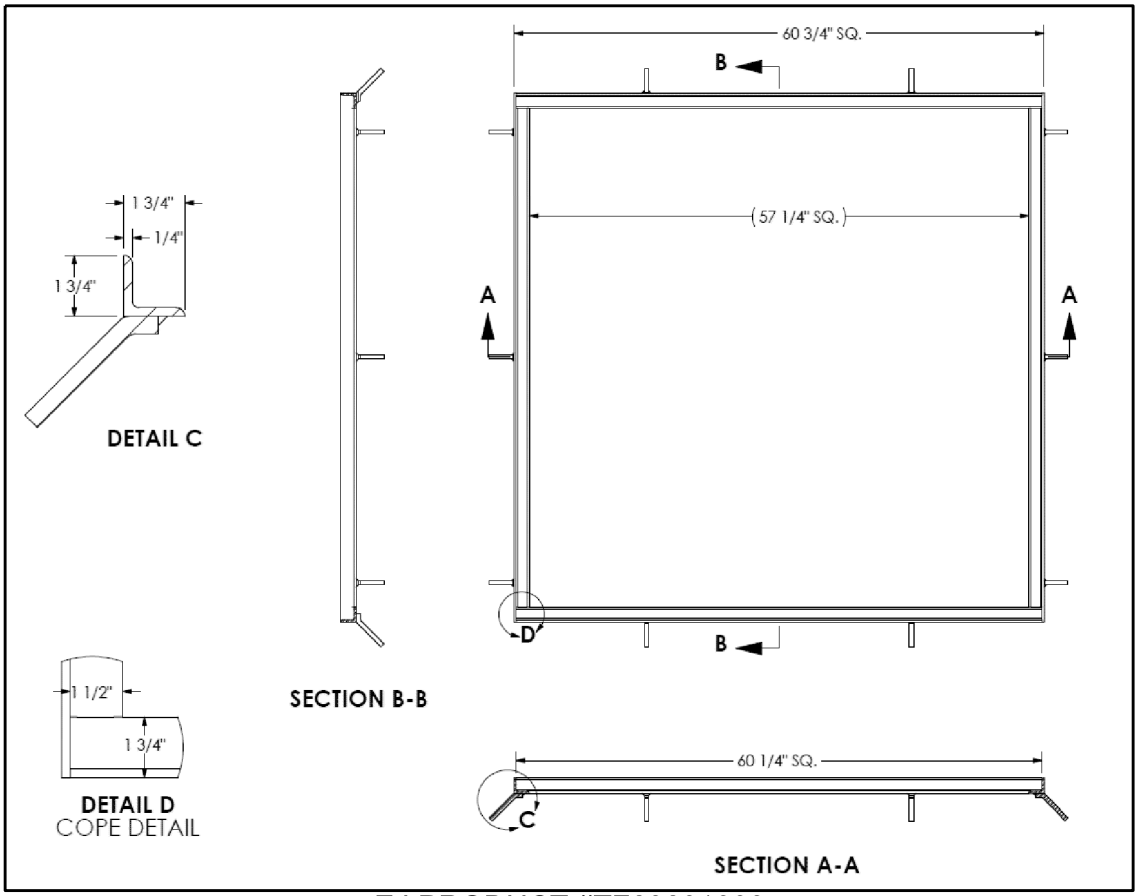

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