CITY OF MILWAUKEE

DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERS

WATER MAIN INSTALLATION SPECIFICATIONS

19 87

MILWAUKEE, WISCONSIN

JANUARY 2, 1987

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CITY OF MILWAUKEE

DEPARTMENT OF PUBLIC WORKS

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MILWAUKEE, WISCONSIN

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PART 1
INSTRUCTIONS TO BIDDERS
GENERAL

CHAPTER 1.1.0

1.1.1 Contracting Officer—

The contracting officer shall be the Commissioner of Public Works of the City of Milwaukee hereinafter referred to as Commissioner.

1.1.2. Qualifications of Bidders—

Qualifications for the project shall be demonstrated by each bidder if requested by the Commissioner of Public Works. Such bidder shall submit within five days of such request written evidence and documentation as required by the Commissioner, including financial capability, previous experience, and evidence of authority to conduct business in the State of Wisconsin.

1.1.3 Examination of Contract Documents and Site—

(a) Before submitting a bid, each bidder shall:

(1) examine the contract documents thoroughly;

(2) visit the site to become familiar with local conditions that may in any manner affect performance of the work;

(3) become familiar with federal, state, and local laws, ordinances, rules and regulations affecting performance of work; and

(4) carefully correlate observations with the requirements of the contract documents.

(b) Before submitting a bid, each bidder shall, at bidder expense, make such surveys and investigations as may be deemed necessary to determine a bid price for performance of the work within the terms of the contract documents.

(c) The submission of a bid shall constitute a prima facie representation by the bidder that the bidder has complied with every requirement of this Paragraph 1.1.3.

1.1.4 Interpretations—

All questions about the meaning or intent of the contract document shall be submitted to the Commissioner in writing. Replies shall be issued by Addenda, mail, or delivery to all parties recorded by the Commissioner as having received the bidding documents. Questions received less than five days prior to the date for opening of bids will not be answered. Only questions answered by formal written Addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect.

1.1.5 Bid Security—

The amount and type of bid security is stated in the Official Notice and Invitation to Bid. The required security must be in the form of cash, certified or bank cashier's check made payable to Commissioner, or when indicated in said Notice or Invitation to Bid, a bid bond issued by a Surety licensed to conduct business in the State of Wisconsin and named in the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Federal Register by the Audit Staff Bureau of Accounts, U.S. Treasury Department. The bid security of the successful bidder shall be retained until the bidder has executed the Agreement and furnished the required contract security, whereupon it will be returned. Upon failure to execute and deliver the contract and furnish the required contract security within ten days of Notice of Award, the Commissioner may annul the Award and the bid security of that bidder shall be forfeited. The bid security of all except the two lowest bidders shall be returned after the opening of bids. The balance of the bid deposits, except that of the lowest responsible bidder, will be returned after the Commissioner has made an award to the lowest responsible bidder.

1.1.6 Bid Proposal—

(a) The Bid Proposal is included in the contract doc-

uments; additional copies may be obtained from the Commissioner.

(b) Bid Proposal shall be completed in ink or typewritten. The bid price of each item on the form must be stated in words and numerals; in case of a conflict, words shall take precedence.

(c) Bids submitted by an individual shall be signed by the bidder or by an authorized agent.

(d) Bids by corporation shall be executed in the corporate name by the president or vice president (or other authorized corporate officer accompanied by evidence of authority to sign), and the corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

(e) Bids by partnerships shall be executed in the partnership name and signed by a partner; the partner's title must appear under the signature, and the official address of the partnership must be shown below the signature.

(f) Bids which are signed by an attorney-in-fact for individuals, firms, partnerships, or joint adventurers shall have attached thereto a power of attorney evidencing authority to sign the bid.

(g) All names shall be typed or printed below the signature.

(h) The bid shall contain an acknowledgment of receipt of all Addenda, if any, the numbers of which shall be filled in on the bid form.

1.1.7 Submission of Bids—

Bids shall be submitted at the place and no later than the date and time indicated in the Official Notice and Invitation to Bid. The bid and the bid security shall be placed in an opaque, sealed envelope marked with the Official Notice Number, project number, branch number, date of opening bids, name and address of bidder, and the type and location of work. Such envelope shall be addressed and delivered to the office of the Commissioner, Room 507, Municipal Building, before time spec-

ified in the Official Notice and Invitation to Bid for opening bids. Bids received later than the date and time indicated will not be considered, and the unopened envelope will be returned.

1.1.8 Modification and Withdrawal of Bids—

Whenever any person submitting a bid for the performance of public work shall claim mistake, omission, or error in preparing a bid, said person may, before bids are opened, formally request withdrawal of the bid, said bid shall then be returned unopened and said person shall not be entitled to bid upon the contract unless the same is readvertised and relet upon such advertisement.

1.1.9 Opening of Bids—

Bids shall be publicly opened at the time and place as indicated in the Invitation to Bid and Official Notice.

1.1.10 Adequacy of Bids—

A bid which appears unreasonable or inadequate for any item in the schedule of quantities stated in the proposal form may be rejected.

1.1.11 Quantities—

The estimated quantities of the work are the result of careful calculations but are not to be considered as final and shall be used as a basis for determining the lowest bidder. After the contract is awarded, the quantity of work listed under any item, or all items, may be increased or decreased a reasonable amount at the discretion of the Commissioner without in any way invalidating the bid price.

1.1.12 Bids to Remain Open—

All bids shall remain open for 45 days after the day of the bid opening or until award of contract whichever occurs first.

1.1.13 Acceptance or Rejection of Bids—

(a) The contract shall be awarded to the lowest responsible bidder with the following reservations: The Commissioner reserves the right to reject all

bids if it appears that the lowest bid for the work to be let is unreasonably high. The Commissioner further reserves the right to reject the bid of any bidder who is, in the judgment of said Commissioner, incompetent or otherwise unreliable for the performance of the work bid or who shall previously have willfully or negligently failed to complete any work or contract entered into with the City or any officer or department thereof or who shall have willfully or negligently failed to enter into a contract with satisfactory Surety for any work that shall have been previously awarded by said Commissioner. The Commissioner further reserves the right to disregard and reject any and all bids.

(b) If the contract is to be awarded, the Commissioner shall give the successful bidder a Notice of Award within forty-five days after the day of the bid opening.

(c) The Contractor shall submit with the executed contract the required performance, payment bond, and any required insurance coverage.

1.1.14 Contract Time—

The number of days or the completion date for the completion of the work (the contract time) is set forth in the Official Notice and the Invitation to Bid and shall be part of the contract. Any provisions for liquidated damages shall be set forth in the Official Notice.

1.1.15 Subcontractors—

(a) If the Conditions or Specifications required the identity of certain subcontractors and other persons and organizations to be submitted in advance of the Award, the apparent low bidder and any other bidder so requested shall within seven days after the day of the bid opening submit to the Commissioner a list of all subcontractors and other persons and organizations, including those who are to furnish the principle items of material and equipment, proposed for those portions of the work as to which such identification is so required. Such list shall be accompanied by an experience statement with pertinent information as

to similar projects and other evidence of qualification for each such subcontractor, person, or organization if requested by Commissioner. If the Commissioner, after due investigation, has reasonable objection to any proposed subcontractor, other person, or organization, the Commissioner may, before giving the Notice of Award, request the apparent low bidder to submit an acceptable substitute without any increase in bid price. If the bidder declines to make any such substitution, such bidder will not thereby sacrifice the bid security. Any subcontractor, other person or organization so listed and to whom City by its Commissioner does not make written objection prior to the giving of the Notice of Award shall be deemed acceptable.

(b) In contracts where the contract price is on the basis of Cost of the Work Plus a Fee, the Contractor, prior to the Notice of Award, must identify in writing to the Commissioner those portions of the work that the Contractor proposed to subcontract and after the Notice of Award may subcontract other portions of the work only with the Commissioner's consent.

(c) Contractor shall not be required to employ any subcontractor, other person, or organization against whom the Contractor has reasonable objection.

1.1.16 Starting Work Before Notification—

No work shall be started under the contract, and no materials or equipment shall be brought upon the site of the work prior to the date named in the written notice to proceed with the work.

PART 2

GENERAL CONDITIONS

DEFINITIONS AND TERMS

CHAPTER 2.1.0

2.1.1 General—

Whenever in the specifications or in any document or instruments in construction operations where the specifications govern, the following abbreviations, terms, or pronouns in place of them are used; the intent and meaning shall be interpreted as follows:

2.1.2 Abbreviations—

(a) A.A.S.H.T.O. The American Association of State Highway and Transportation Officials.

(b) ADMINISTRATIVE CODE. Rules of Wisconsin Code.

(c) A.N.S.I. American National Standards Institute.

(d) A.R.E.A. The American Railway Engineering Association.

(e) A.S.M.E. The American Society of Mechanical Engineers.

(f) A.S.T.M. The American Society for Testing and Materials

(g) A.W.W.A. The American Water Works Association.

(h) D.N.R. Wisconsin Department of Natural Resources.

(i) FEDERAL SPECIFICATIONS. The Specification of the United States Federal Specifications Board.

(j) O.S.H.A. Federal Occupational Safety and Health Administration.

(k) S.S.P.C. Steel Structures Painting Council.

(l) STATE SPECIFICATIONS. Current Standard Specifications for Road and Bridge Construction of the Wisconsin Department of Transportation.

(m) A.C.I. American Concrete Institute.

(n) A.G.M.A. American Gear Manufacturers' Association.

(o) A.I.A. American Insurance Association.

(p) A.I.S.C. American Institute of Steel Constructions.

(q) A.S.C.E. American Society of Civil Engineers.

(r) A.W.S. American Welding Society.

(s) I.E.E.E. Institute of Electrical and Electronic Engineers.

(t) J.I.C. Joint Industry Conference.

(u) N.E.C. National Electrical Code.

(v) N.E.M.A. National Electrical Manufacturers' Association.

(w) P.C.A. Portland Cement Association.

(x) P.C.I. Prestressed Concrete Institute.

2.1.3 Contract Documents—

All the integral documents of the contract comprised of (a) written agreement (contract) covering the performance of the work and furnishing of materials for the construction of the work, (b) official notice, (c) invitation to bid and bid, (d) instructions to bidders, (e) specifications, (f) special provisions, (g) special conditions when applicable, (h) plans, (i) schedule of fixed prices, (j) supplemental agreements, and (k) all addenda, as fully as though they had been set forth therein full in the body of the contract.

2.1.4 City—

The City of Milwaukee, a municipal corporation of the State of Wisconsin, located in the County of Milwaukee.

2.1.5 Commissioner of Public Works, Commissioner or C.P.W.—

The Commissioner of Public Works of the City of Milwaukee.

2.1.6 Bidder—

Any individual, firm, partnership, corporation, or a combination of any or all jointly submitting a proposal for the work contemplated, acting directly or through a duly authorized representative.

2.1.7 Contractor—

Any individual, firm, partnership, corporation, or a combination of any or all jointly submitting a proposal to whom the contract is awarded by the City or its heirs, executors, administrators, successors, or assigns.

2.1.8 Subcontractor—

The individual, firm, partnership, or corporation to whom the Contractor, with the written consent of the Commissioner, sublets, assigns, or otherwise disposes of any part of the work covered by the contract documents.

2.1.9 Surety—

The approved Surety corporation licensed to do business in the State of Wisconsin bound with and for the Contractor to insure acceptable performance of the contract and for payment of all obligations under the contract.

2.1.10 Plans—

All contract drawings, reproductions of drawings, sketches, and revisions thereof pertaining to the work covered by the contract.

2.1.11 Addenda—

All revisions of and supplements to the plans and specifications incorporated in or attached to and becoming an integral part of the contract documents.

2.1.12 Special Provisions—

The special body of directions, provisions, or requirements peculiar to a project and otherwise not thoroughly or satisfactorily detailed or prescribed in the specifications. The requirements of these Special Provisions shall govern the work and shall take precedence over the specifications or plans whenever they conflict.

2.1.13 City Datum—

The plane of zero elevation used for City work, being 54.815 feet below the permanent bench mark on a stone monument located near the northwest corner of North Jackson and East Wells Streets.

2.1.14 Pavement—

All types of pavements except such surfacings as crushed stone, screenings, cinders, or untreated water-bound macadam.

2.1.15 Work—

Work shall be understood to mean the furnishing of all labor, materials, equipment, and other incidentals necessary for the successful completion of the project or particular part of the project in accordance with the requirements of the contract.

2.1.16 Engineers—

The Engineers of the Department of Public Works assigned to the work.

2.1.17 Milwaukee Code—

The Milwaukee Code of Ordinances, being the revision and codification of the general ordinances of the City of Milwaukee, adopted by the Common Council on December 19, 1941, and supplements and amendments thereto.

2.1.18 Emergency or Emergencies—

Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection of work already done under the contract documents or

which endanger life or property and call for immediate action or remedy.

2.1.19 Trade Terms—

Terms having a well-known technical or trade meaning and generally recognized by architects, engineers, and the trade.

2.1.20 Date of Completion of Work—

The work shall be considered as completed on the date certified to the Commissioner by the Engineer in Charge or other authorized representative.

2.1.21 Time Allowed for Completion—

The time allowed the Contractor to complete all work under the contract including cleaning of the work site will be specified in the official notice. This time will be specified either as number or working days allowed, number of calendar days allowed, a specified calendar date, or a combination of these when a specific portion of the work is to be completed by a specific date. If any of these requirements are exceeded, Section 2.5.11 of the Specifications shall be invoked.

2.1.22 Advertisement—

The official notice inviting bids for all proposed work included in any one letting.

2.1.23 Award—

The acceptance of a bid by the Commissioner.

2.1.24 Calendar Days—

Every day shown on the calendar, Sundays and holidays included.

2.1.25 Contract Bond—

The approved form of security furnished by the Contractor and Surety as a guarantee of good faith on the part of the Contractor to execute the work in accordance with and complying with all the terms and conditions of the Contract Documents.

2.1.26 Contract Change Order—

A written order by the Commissioner or the Commissioner's authorized representative covering work not otherwise provided for, revision in or amendments to the contract, or conditions specifically prescribed in the specifications as requiring contract change orders. Such document becomes a part of the contract.

2.1.27 Contract Period—

The period from the date of commencing work to the date of completing work, both dates inclusive, as specified in the contract.

2.1.28 Inspector—

The authorized representative of the City assigned to make a detailed inspection of any and all portions of work or materials thereof.

2.1.29 Official Notice—

The advertisement for proposals for all work or materials on which bids are required. Such advertisement will indicate with reasonable accuracy the location and character of the work to be done or materials to be furnished and the time and place of submitting the proposals.

2.1.30 Notice to Proceed—

A written notice to the Contractor by the Commissioner or the Commissioner's authorized representative of the time within which the Contractor shall begin the prosecution of the work.

2.1.31 Proposal—

The offer of the bidder, submitted on the prescribed proposal form, to perform the work including the furnishing of labor and materials at the prices quoted by the bidder.

2.1.32 Proposal Form—

The approved form on which the City requires bids to be prepared and submitted for the work.

2.1.33 Bid Security—

The security furnished with a bid to guarantee that the bidder will enter into the contract if the bid is accepted.

2.1.34 Schedule of Fixed Prices—

The fixed prices as listed in the Contract Documents.

2.1.35 Working Day—

A working day shall be any calendar day where, in the opinion of the Commissioner or his duly authorized representative, it is possible for the Contractor to start and continue work, except that unless the Contractor actually starts and continues work on days of inclement weather, Saturdays, Sundays, and nationally-recognized legal holidays, such days shall not be considered as working days.

CHAPTER 2.2.0 EMPLOYMENT OF LABOR

2.2.1 Hours of Labor and Overtime Pay—

In accordance with Section 2-280, Milwaukee Code: The service of all laborers and mechanics who are now or may hereafter be employed by any Contractor or subcontractor of the City of Milwaukee upon any of the public works of this City is hereby limited to days other than Saturdays, Sundays, and legal holidays and restricted to 40 hours per week of which no more than eight hours shall occur in any one calendar day; and except as the Commissioner may approve to conform with occupational practices or as specifications may require, it shall be unlawful for any officer of the City government or any such Contractor or subcontractor, whose duty it shall be to employ, direct, or control the services of such laborers or mechanics, to require or permit any such laborer or mechanic to work Saturdays, Sundays, and legal holidays or more than 40 hours per week and eight hours in any calendar day, except in cases where, in the opinion of the Commissioner, an emergency exists. In such instances where overtime work has been permitted and laborers or mechanics are required to work more than eight hours per day or 40 hours per week or at times other than the normal work

day or work week, they shall be paid by the Contractor in accordance with the prevailing overtime wage rates. When, and only when, an emergency has been declared to exist and the Commissioner, after the signing of a contract, has ordered in writing that work on a project be carried on in excess of eight hours per day or 40 hours per week, it shall be the duty of the City to reimburse the Contractor over and above the price agreed upon for the performance of such work in the amount of the premium paid for overtime work or work performed at times other than the normal work day or work week in accordance with the prevailing overtime wage rates plus any premium paid for necessary materials because of delivery during times other than the normal work day or work week.

2.2.2 Minimum Wage Rate—

In accord with Section 2-282, Milwaukee Code, and Res. No. 68-1317, building and construction industry trade workers employed upon public works contracts by any Contractor or subcontractor shall be paid no less than the wage rates and fringe benefits approved by the Common Council for their respective trades or occupations. Such wage rates shall be incorporated into the contract.

2.2.3 Unclassified Employees—

In case it becomes necessary for the Contractor or any subcontractor to employ on the work covered by the contract documents any person in a trade or occupation (except executive, supervisory, administrative, clerical, or other nonmanual workers) for whom no minimum wage rate is herein specified, the Contractor shall immediately notify the Commissioner who shall promptly thereafter furnish the Contractor with the minimum wage rate for such person.

2.2.4 Minimum Wage — Time Reports—

The Contractor hereby agrees to make a sworn report or affidavit within ten days following the Contractor's completion of a contract or every three months, whichever occurs first and shall procure and submit a like sworn report or affidavit from every subcontractor employed in the work to the Commissioner of every em-

ployee employed on or under this contract or subcontract and shall include, for the specified period but not be limited to, the employee's name, address, type of work performed, total hours worked, hourly rate, gross earnings, and employer's contribution to vacation, welfare, and pension trust funds. Said reports of Contractor or subcontractor shall include a statement that each and every employee has been paid in full the amount prescribed by the Common Council and that there has not been, nor is to be, any rebate or refund of any part of said wages by employee to employer.

The Commissioner or other officers are hereby ordered not to pass any estimate for payment on any contract in which the Contractor or subcontractor has failed to comply with all the provisions of the foregoing sections, and no estimate shall be so passed for payment until the Commissioner is satisfied that the provisions of the foregoing specifications have been fully complied with.

2.2.5 Provision of Wisconsin Statutes and Administrative Code Pertaining to Municipal Wage Rates—

Pursuant to Section 66.293, Wisconsin Statutes and Section Ind 90.13 and 90.14 of the Wisconsin Administrative Code, each Contractor and subcontractor is subject to the following requirements.

Each Contractor, subcontractor, or agent thereof participating in a project shall keep full and accurate records clearly indicating the name and trade or occupation of every laborer, worker, or mechanic employed in connection with the project and an accurate record of the number of hours worked by each employee and the actual wages paid therefore.

Upon completion of the project and prior to final payment therefore, each Contractor shall file with the municipality an affidavit stating compliance with the provisions and requirements of the Wisconsin Statutes and Administrative Code and that said contractor has received evidence of compliance from each subcontractor. No municipality may authorize final payment until such an affidavit is filed in proper form and order.

Upon completion of the subcontractor's portion of the work and prior to final payment, each subcontractor

shall file with the Contractor an affidavit stating that said subcontractor has fully complied with the provisions and requirements of Section 66.293 (3) Wisconsin Statutes and the Wisconsin Administrative Code Chapter Ind 90.

In accordance with Section 66.293 (3) (h), each Contractor shall file with the City copies of the subcontractor's affidavit prescribed under Ind 90.13 Wisconsin Administrative Code.

2.2.6 Enforcement of "Hours and Wages" Provisions—

Section 2-289, Milwaukee Code, provides that any person, firm, or corporation violating the provisions of either the "Hours of Labor and Overtime Pay," Section 2-280, Milwaukee Code, or the "Minimum Wage Rate," Section 2-282 and 2-287, Milwaukee Code, will, upon conviction, be punished by a fine not to exceed 25 dollars and in dafult of payment thereof by imprisonment in the Milwaukee County House of Correction for a period not to exceed 90 days. The employment of each person contrary to the provisions of said sections will be deemed a separate violation of the provisions thereof for each day so employed.

Attention is called to Section 66.293, Wisconsin Statutes, 1951, which provides that a Contractor who violates the provision of this law, to-wit, fails to comply with the municipal wage scale set forth in the contract may be fined not to exceed $500 for each offense. The failure to pay the required wage to an employee for only one week or part thereof constitutes a separate offense.

2.2.7 Wage and Hours Limitation—

The provisions of Section 2-280 to 2-289, both inclusive, of the Milwaukee Code, shall apply, and the Contractor or any subcontractor is not to pay less than the minimum wage scale adopted by the Common Council of the City of Milwaukee pursuant to said provisions.

2.2.8 Days of Work and Shift Regulations—

No work shall be performed under the contract on Saturdays, Sundays, or legal holidays, except in cases of emergency, and then only with the approval of the Commissioner.

The Commissioner reserves the right to name the number of shifts per day, the hours per shift, and the starting time of each shift.

2.2.9 Wage and Hours Disputes—

Whenever a dispute arises between the Contractor or Surety and the City as to the determination whether there is compliance with the provisions of the contract documents as to the hours of labor, wages, character, and classification of workers employed, the determination of the Commissioner shall be final, and in case of violations of said provisions, the Commissioner may declare the contract in default and order the Surety to perform or relet upon advertisement, the remaining portion of the contract as provided by Section 66.29 (8), Wisconsin Statutes, 1943.

2.2.10 Disqualification of Contractor—

As provided by Section 2-288, Milwaukee Code, whenever any Contractor or subcontractor engaged in any public work of the City has been found by the Commissioner, officer, or employee of the City or by a court of competent jurisdiction to have infringed any of the provisions of the minimum wage ordinance or any ordinance or any resolution or scale of wages adopted pursuant thereto, in that event any such contractor or subcontractor shall not be deemed to be a competent and reliable bidder in the sense of Section 7.14 of the Milwaukee City Charter, 1977 compilation, and such Contractor or subcontractor shall not be allowed to compete in securing future contracts with the City by such individual, or partner, or agent, or by any corporation of which such individual is a member, for a period of one year. A second violation by such individual, or partner, or agent, or by any corporation of which such individual is a member, shall disqualify such individual, or such partner, agent, or corporation from competing or doing any future City work for a period of two years.

2.2.11 Lien Law—

All provisions of Chapter 261, Laws of Wisconsin, 1882, entitled "An act to amend Chapter 332 of the laws of 1878, entitled 'An act to protect laborers and material men in the City of Milwaukee' " and all, if any, subse-

quent amendments thereto, shall be binding upon the Contractor.

2.2.12 Discrimination in Employment—

In accord with Section 109-15, Milwaukee Code and federal guidelines, it shall be unlawful for any private employer performing work within the City involving any public works of the City to willfully refuse to employ or to discharge any person otherwise qualified because of race, color, religion, sex, sexual orientation, age, handicap, national origin, physical condition, developmental disability, or ancestry; to discriminate for the same reason in regard to tenure, terms, or conditions of employment; to deny promotion or increase in compensation solely for these reasons; to publish offer of employment based on such discrimination; to adopt or enforce any rule or employment policy which discriminates between employees on account of race, color, religion, sex, sexual orientation, age, handicap, national origin, physical condition, developmental disability, or ancestry; to seek such information as to any employee as a condition of employment; to penalize any employee or discriminate in the selection of personnel for training, solely on the basis of race, color, sex, sexual orientation, age, handicap, national origin, physical condition, developmental disability, religion, or ancestry.

The Contractor shall include or cause to be included in each subcontract covering any of the work covered by this contract a provision similar to the above paragraph, together with a clause requiring such insertion in further subcontracts that may in turn be made.

CHAPTER 2.3.0 NECESSARY NOTICES AND PERMITS

2.3.1 Notice to Proceed with Work—

The Commissioner shall notify the Contractor of the date to commence work covered by the contract. Upon receipt of such notice the Contractor shall comply with all notice requirements set forth below and in the specifications.

2.3.2 Notice to Fire, Police, and Sheriff—

The Contractor shall give notice in writing to the Chief Engineer of the Fire Department and to the Chief of Police of the City of Milwaukee and to the Sheriff of Milwaukee County at least three days before blocking off any street.

2.3.3 Notice to Utilities, City Bureaus and Governmental Units—

The Contractor shall notify all utilities, City bureaus, and governmental units whose property may be affected by the Contractor's operations at least three days before breaking ground. The Contractor shall not interfere with said property until the expiration of the time specified in said notice and then only by permission of the Commissioner nor shall the Contractor hinder or interfere with any person in the protection of such work or with the operation of buses at any time except with the permission of the Commissioner.

2.3.4 Notice to Railroads—

The Contractor shall send by registered mail a notice to the district or division engineer or persons in charge of the operations of trains for any railroad at least ten days prior to doing any work in the right-of-way or any track zone. Such Contractor shall ascertain the schedule of all trains and shall comply with all rules and regulations requested by the railroad company.

2.3.5 Notice for State Arterial Highways—

Whenever the work will obstruct or in any other way affect through vehicular traffic on State arterial highways, the Contractor shall give notice at least three days in advance thereof to the State of Wisconsin, Department of Transportation, Division of Highways, and the Traffic Division of the Bureau of Traffic Engineering and Electrical Services of the City.

2.3.6 Notice to Support Buildings—

Whenever the work endangers the support or involves the undercutting of any building or other structure along the site of work, the Contractor shall send by registered mail, return receipt requested, a written notice

to the owner or the owner's agent to support such building or structure, and following the service of the notice, the Contractor shall allow a reasonable length of time for the placing of the necessary support. Such notice shall be in accordance with applicable law.

2.3.7 Notice of Work Suspension—

In case the work is stopped and is to remain stopped for any considerable length of time, the Contractor shall promptly notify the Commissioner. At least three days before the work is to be resumed, the Contractor shall again notify the Commissioner.

2.3.8 Permits and Licenses—

The Contractor shall procure all necessary permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work.

2.3.9 Permit for Parks and Parkways—

The Contractor shall obtain a permit from the local park authority for construction work to be done within the limits of parks or parkways.

2.3.10 Permit for Storage of Materials—

When the Contractor finds it necessary to store materials on a street which is open to traffic, such Contractor shall obtain a permit from the Department of Public Works to store such materials at the designated location.

2.3.11 Water Permit—

The Contractor shall obtain a permit from the Milwaukee Water Works for the use of City water. This does not apply to contracts for laying water mains.

2.3.12 Permit for Excavation—

Before starting excavation in any street, roadway, or other public way, the Contractor must obtain a permit from the Department of Public Works.

2.3.13 Permit for Street Closings—

When it is necessary to close any street to traffic, the Contractor shall obtain a permit from the Department of Public Works.

2.3.14 Permit for Blasting—

Before doing any blasting the Contractor shall, with the approval of the Commissioner, obtain a permit from the Building Inspector. The Commissioner reserves the right to order the discontinuance of blasting operations at any time.

2.3.15 Copies of Notices and Permits—

Copies of all written notices and permits shall be submitted to the Commissioner or the Commissioner's representative prior to the commencement of construction.

CHAPTER 2.4.0 CONTROL OF WORK AND MATERIALS

2.4.1 Plans and Specifications to be Available—

The Contractor shall keep a legible copy of the plans, if any, and specifications at the site of the work.

2.4.2 Contractor's Representative—

The Contractor shall either give personal superintendence to the work and be present, or shall have at the site of the work at all times while work is in progress a representative having authority both to receive orders from the Commissioner and to act for the Contractor. Such representative must be thoroughly familiar with the work and be acceptable to the Commissioner and must be capable of reading and understanding the plans and specifications and capable of directing the work as called for by the contract documents.

2.4.3 Authority and Duties of Inspectors—

Inspectors employed by the City shall be authorized to inspect all work done and all material furnished. Such inspection may extend to all or any part of the

work and to the preparation, fabrication, or manufacture of the materials to be used. The Inspector is not authorized to revoke, alter, or waive any requirements of the specifications, nor is the Inspector authorized to approve or accept any portion of the completed project. The Inspector shall call the attention of the Contractor to any failure of the work or materials to conform to the specifications and contract and shall have the authority to reject materials. Any dispute between the Inspector and Contractor shall be referred to the Commissioner. Any advice which the Inspector may give the Contractor shall in no way be construed as binding the Commissioner or the Commissioner's representative in any way or releasing the Contractor from fulfilling any of the terms of the contract.

2.4.4 Performance of Work—

All work to be performed must be in accordance with the contract documents and subject to the supervision, approval, and acceptance of the Commissioner.

2.4.5 Materials, Labor, Equipment, Etc.—

All construction materials to be used on the work, all materials to be incorporated into the work, and all labor, equipment, plant, tools, appliances, or methods to be used on the work shall be subject to the inspection and approval or rejection of the Commissioner.

It is understood that, except as otherwise specifically stated in the contract documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other service and facilities of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

2.4.6 Decisions of the Commissioner—

All work shall be done in compliance with the contract documents. The Commissioner shall decide all questions which shall arise as to the quality and acceptability of materials furnished, work performed, manner of performance, extensions of time, rate of progress of the work, interpretation of the plans and specifications, acceptable fulfillment of the contract, compensation,

disputes, and mutual rights between Contractors under the Specifications. All questions as to the meaning of the contract documents and all questions as to the interpretation of any orders or directives which may have been issued in connection with the work shall be decided by the Commissioner whose decision shall be considered final and conclusive between the parties hereto and binding upon them.

2.4.7 Order of Work—

The place of commencement, the sequence of operations, and the prosecution of the work may be determined by the Commissioner as he shall deem fit to best serve the needs and the convenience of the public and for the proper and timely completion of the contract.

2.4.8 Regulations of Tools, Equipment, and Plant Usage—

The Commissioner reserves the right to regulate the time of usage or to prohibit the use of any type or kind of tools, equipment, and plant which may cause objectionable smoke, noises, odors, or damage to property.

2.4.9 Steam-Powered Equipment—

The Commissioner reserves the right to prohibit the use of any or all steam-powered equipment when such usage would cause objectionable noises or damage to property or to overhanging trees. When the use of steam-powered equipment is permitted, such equipment must be provided with a hood which shall be placed over the stack, when necessary, to prevent the escape of dangerous sparks, to diffuse the hot gases, and to serve as a protection to overhead tree branches.

2.4.10 Gas-Powered Equipment—

The Commissioner reserves the right to prohibit the stationary use of gas- or diesel-powered plant equipment when such usage would cause objectionable noises, odors, or damage to property or trees.

2.4.11 Electrically-Powered Plant—

Where conditions are such that, in the opinion of the Commissioner, an electrically-powered plant should be

used, the Commissioner shall have the right to order the Contractor to furnish an adequate plant powered by electric service.

2.4.12 Location and Type of Plant—

The location and type of any plant, at the site of the work, including buildings, machinery, equipment, and tools, is subject to the approval of the Commissioner. If these are furnished, placed, or used without approval, the Commissioner may require the removal and substitution of any or all parts of the plant, including buildings, machinery, equipment, and tools, to a location and of a type acceptable to the Commissioner.

2.4.13 Right to Inspect and Test Materials—

All materials to be used in the work are subject to the inspection, testing, and approval of the Commissioner or the Commissioner's authorized representatives at the place of manufacture, the site of the work, or other location, and before use, or before, during, or after the incorporation of such materials into the work. The Contractor shall, at all times, afford the necessary facilities for the Commissioner and the Commissioner's representatives to examine or sample all materials and to inspect the work, plant, equipment, and tools in order to determine whether the materials, operations, workmanship, methods, and finished work comply with the requirements of the contract documents.

2.4.14 Inspection—

All materials and each part or detail of the work shall be subject at all times to inspection by the Commissioner or the Commissioner's authorized representatives, and the Contractor shall be held strictly to the true intent of the specifications in regard to quality of materials, workmanship, and the diligent execution of the contract. Such inspection may include mill, plant, or shop inspection, and any material furnished under these specifications is subject to such inspection. The Commissioner or the Commissioner's representatives shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is determined by the Commissioner or the Commissioner's representative to make a complete and detailed inspection.

The Contractor shall, if the Commissioner requests, remove or uncover such portion of the finished work as the Commissioner may direct before the final acceptance. After the examination, the Contractor shall restore said portion of the work to the standard required by the specifications. If the work thus exposed or examined proves acceptable, the expense of uncovering or removing and replacing the parts removed shall be paid for as extra work but, if the work so exposed or examined is unacceptable, the expense of the uncovering or removing and replacing in accordance with the specifications shall be borne by the Contractor.

Failure or negligence on the part of the Commissioner to condemn or reject substandard or inferior work or materials shall not be construed to imply an acceptance of such work or materials, if it becomes evident at any time prior to the final acceptance of the work by the City. Neither shall it be construed as barring the City at any subsequent time from the recovery of damages or of such a sum of money as may be needed to build anew all portions of the substandard or inferior work or replacement or improper materials wherever found.

Any portion of the work or any material incorporated into the work, which may have become damaged during the progress of the work, shall be removed and replaced at the expense of the Contractor prior to final inspection and acceptance of the work.

2.4.15 Source of Supply—

The Commissioner reserves the right to prohibit the use of materials from any source when such material is known to the Commissioner to be inferior and from any plant when its mode of operation is known to the Commissioner to be such as to make improbable the supplying of reasonably uniform material.

2.4.16 Or Equal Clause—

Whenever a material, article, or piece of equipment is identified on the plans or in the specifications by reference to manufacturers or vendors names, trade names, catalogue numbers, etc., it is intended merely to establish a standard, and any material, article, or equipment of other manufacturers and vendors which will perform adequately the duties imposed by the general design

shall be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the Commissioner, of equal substance and function. It shall not be purchased or installed by the Contractor without the Commissioner's written approval.

2.4.17 Continuous Work—

The Contractor shall execute the work only in the presence of the Commissioner or the Commissioner's representative during the working hours of the day unless, at the Contractor's own volition upon due notice to the Commissioner and with the Commissioner's approval, the Contractor desires to prosecute the work continuously or at night. In all cases, the Contractor shall provide such facilities for carrying on night work as the Commissioner directs. No claims shall be allowed for extra payment on account of night or continuous work nor for damages or detriment to the quality of work which may be incurred by the Contractor in being permitted to carry on work during such time, it being understood that full compensation for night or continuous work and all expenses incident thereto are included in the prices for the various items in the contract.

2.4.18 Progress of the Work—

The Contractor shall proceed with diligence to do the work and shall work continuously without delay. The Contractor shall not suspend operations at his discretion for whatever purpose without City of Milwaukee approval. It is the intent under this Section of the General Specifications that the work proceed continuously and expeditiously to completion irrespective of time allowed for completion of the work. Should the Contractor fail to prosecute the work continuously and expeditiously, the Commissioner may invoke the provision of Section 7.14(2) of the Milwaukee City Charter with a recommendation to the Common Council that the Contractor is not deemed to be a competent and reliable bidder and be disbarred from bidding for a period of time. If interruption of the work occurs during the term of contract which is beyond the control of the Contractor, i.e., strikes, governmental regulations, severe shortage of building materials, fires, or floods which are entirely beyond the control of the Contractor, the Contractor shall within such time as the Commissioner

deems reasonable present written notice of such conditions to the Commissioner with a request for interruption of the work or an extension of the time for the completion of the entire contract. If said delays are approved by the Commissioner, such delays will entitle the Contractor to an extension of time as provided herein, but the Contractor shall not be entitled to damages or additional payment due to these delays. Whenever the Commissioner shall have taken action for the reasons described above to change the term of the contract described in this agreement, it is incumbent upon the Contractor to notify the Surety of such change.

Should the Contractor fail to maintain the rate of progress required to complete the work within the contract time specified, the Commissioner may require that additional workers or equipment be placed on the work or a reorganization of plant layout be effected in order that the work be brought up to schedule and maintained there. Should the Contractor fail to comply therewith, the Commissioner may proceed under the provisions of Subsection 2.4.19 of these Specifications.

In the event work is prosecuted during adverse weather conditions, the Contractor will be required to exercise precautions necessary to produce satisfactory work and shall protect the finished work from the elements. It is agreed and understood that the cost thereof has been included in the unit prices bid for the various items of work in the contract and that no extra compensation be allowed therefore.

2.4.19 Default and Completion of Work—

The Commissioner has the right, in case of the improper or imperfect performance of the work, to suspend the work at any time and to order the entire reconstruction of the same or to relet the same to some other competent party. The Commissioner has the right, in case the work shall not be prosecuted with such diligence and with such number of employees to insure its completion within the time limited by the contract documents, to suspend such work and relet the same to some other competent party or employ personnel and secure material for the completion of the same and charge the costs thereof to the Contractor.

When the Contractor or Surety, both if locally availa-

ble, are notified that the Commissioner has elected to suspend the work, the Contractor shall cease to have the right to occupancy of the work site, and the Commissioner shall have the right to forthwith take possession of any materials, tools, equipment, or plant delivered thereon for work under the contract.

The Surety shall have the right to complete the contract, but in the event that performance has not been commenced within ten days from the date of the notice of suspension, the Commissioner has the right to continue in the possession of and utilize, for the completion of the contract, any and all materials, tools, equipment, and plant which the Contractor has had delivered upon the site of the work and to prosecute the work to completion either by force account or by contract.

Expenditures made by the Commissioner in completing the work under the contract and in payment of valid claims arising under the terms of the contract shall be deducted from monies due or which would have become due to the Contractor upon completion of the contract. No claims for "extras" arising from the Commissioner's actions in completing the work will be entertained. The Contractor and Surety shall be liable and shall reimburse the City for any costs in excess of the contract amount, required to complete the work.

2.4.20 Assumption of Control of Work Not a Waiver—

Neither the acceptance of any work by the Commissioner nor any order, measurement, or certificate by the Commissioner for payment of money nor any payment for nor acceptance of the whole or any part of the work by the Commissioner, nor any extension of time except for causes beyond the control of the Contractor as set forth above nor any possession taken by the City or its employees shall operate as a waiver of any portion of this contract or of any power herein reserved to the City or any right to damages herein provided nor shall any waiver of any breach of this contract be held to be a waiver of any other or subsequent breach.

2.4.21 Workmanship—

All workmanship shall conform to the best standard practice. Unless otherwise specified, the specifications of recognized association of manufacturers and contrac-

tors or industrial manufacturers shall be used as guides for the standards of workmanship.

All exposed items of work shall present a neat workmanshiplike appearance and shall be as true to shape and alignment as is possible to obtain with measuring or leveling instruments generally used in the respective types of work. Items of work shall be sound and fully protected against damage and premature deterioration. It is specifically understood that in all questions of quality and acceptability of workmanship, the Contractor agrees to abide by the decisions of the Commissioner.

The Contractor shall furnish all labor, materials, necessary tools, equipment, and accessories that are necessary for integrating all portions of the work included in the contract to fulfill the true purpose and intent of the contract.

2.4.22 Partial Acceptance—

When requested by the Contractor and upon specific approval of the Commissioner prior to final inspection and acceptance, the Contractor may be relieved of maintenance of sections of the work which have been completed. Such partial acceptance and assumption of the maintenance by the City shall be covered by a written notice from the Commissioner to the Contractor, and such notice shall definitely designate the sections of the work on which the Contractor is to be relieved of maintenance and shall also set forth the date upon which such notice will be effective. The assumption of maintenance by the City, however, shall not relieve the Contractor of any responsibility for defective workmanship or materials or for damages caused by the Contractor's own operations.

Such action shall not be construed to be a final inspection or acceptance of any part of the work nor waiver of any legal rights.

2.4.23 Final Acceptance—

The Commissioner shall make an inspection of the work included in the contract as soon as practical after notification by the Contractor and confirmation by the

Inspector that such work has, in their opinion, been completed and final cleanup performed.

Should the inspection disclose any work in whole or in part as being unsatisfactory, the Commissioner shall give the Contractor the necessary instructions for correction of the same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed.

All work included in the contract shall be considered accepted on the date certified to the Commissioner as completed by the Engineer in Charge or other authorized representative.

2.4.24 Employee Qualifications—

The Contractor shall employ only such foremen, mechanics, laborers, or other employees as are physically fit, competent, experienced, and qualified to handle each class of work on which they are employed. Any person previously discharged by order of the Commissioner from work on any City contract shall not be permitted to work on this contract without first obtaining written permission from the Commissioner.

2.4.25 Employees to be Discharged for Cause—

When any employee willfully, negligently, or ignorantly fails to perform any of the duties or assignments or is disobedient or abusive and disrespectful to a fellow employee or to the Commissioner or the Commissioner's representative, such employee shall, upon written order from the Commissioner to the Contractor, be discharged from the work.

2.4.26 Blasting—

In all blasting operations, the Contractor shall abide by all provisions of Section 32-26, Milwaukee Code of Ordinances.

2.4.27 Right of Entry—

The Commissioner reserves the right of entry to any portion of the site of the work. Such right of entry shall also be available to the City forces, utilities, or contrac-

tors for the purpose of constructing collateral work or making emergency repairs. The Contractor shall not be entitled to any damages for delays or hindrances resulting from such work.

2.4.28 Guarantee—

Contractor guarantees the work performed under this contract for the period set forth in the technical specifications.

CHAPTER 2.5.0 SCOPE OF WORK AND SPECIFIC INSTRUCTIONS

2.5.1 Intent of Contract Documents—

The true intent of the contract documents is to provide for the construction, execution, and completion in every detail of a complete work or improvement which the Contractor undertakes to do in full compliance with the contract documents and in accordance with recognized engineering and construction principles. The Contractor shall perform all items of work covered and stipulated in the proposal and perform altered and extra work, all in accordance with the lines, grades, typical sections, and dimensions given and shall furnish, unless otherwise provided in the contract documents, all material, implements, machinery, equipment, tools, supplies, transportation, electric power and labor necessary to the prosecution and completion of the work.

2.5.2 Location of Underground Structures—

It is the responsibility of the Contractor to become acquainted with the location of all underground structures which may be encountered or which may be affected by work under the contract.

The locations of any underground structures furnished, shown on the plans, or given on the site are based upon the available records but are not guaranteed to be complete or correct and are given only to assist the Contractor in making a determination of the location of all underground structures.

2.5.3 Harmonious Relations—

The Contractor shall work in harmony with other contractors or with utility or City forces engaged in collateral work. The Contractor's operations shall be arranged to prevent interference or damage to the work of others. In case of dispute the decision of the Commissioner shall be final and binding upon the parties affected.

2.5.4 Cleaning of Work Site—

The Contractor shall at all times keep the site of the work, including streets, alleys, and all private or public property involved in or adjacent to the work free from any rubbish, surplus, or waste materials that have been deposited by the employees or which have accumulated as a result of the work.

The Contractor shall remove all surplus materials, tools, equipment, or plant, leaving the site of the work and all portions of the finished work clean, unobstructed, and ready for use before the work will be considered completed. The Commissioner may have removed from the site of the work all rubbish, surplus, or waste materials which the Contractor has neglected or refused to remove and deduct the costs of such removal from any monies due the Contractor.

2.5.5 Items Not Listed in "Estimate of Quantities"—

Sundry items which are incident to or required in the construction of the work but are not included as items in the estimate of quantities shall be considered an integral part of the contract, and all labor, materials, etc., required for such items shall be furnished by the Contractor and the cost of same included in the unit prices bid.

2.5.6 Omissions, Discrepancies, and Corrections—

It is the intent of the contract documents that all performance under the contract be in accordance with the best practice. The Contractor shall carefully check the plans both before commencing and throughout the work. The Contractor shall immediately call the Commissioner's attention to any errors, omissions, or discrepancies that the Contractor may discover in the

plans before proceeding with the work affected. The Commissioner reserves the right to make such corrections as deemed necessary for the fulfillment of the true intent of the contract documents.

2.5.7 Work to be Done at Contractor's Risk—

All work to be done under the contract documents from the commencement until the final acceptance of such work shall be done entirely at the Contractor's risk. No partial payment for, or partial acceptance of, any part of the work shall absolve the Contractor from such risk.

2.5.8 Guarantee—

The Contractor shall be liable for the acceptable condition of all work under the contract, both during construction and throughout any guarantee period. The guarantee period, if any, shall commence on the Date of Completion. If, within said guarantee, repairs, or changes are required in connection with the work, which, in the opinion of the Commissioner, is rendered necessary as a result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the contract, the Contractor shall promptly, upon receipt of the notice from the Commissioner and without expense to the City, install the work to a satisfactory condition, correct all defects, make good all damage to the structure, site, or contents thereof, which damage, in the opinion of the Commissioner, results from the use of such inferior or defective materials, equipment, or workmanship.

2.5.9 Breakdown for Partial Estimates—

Whenever the Commissioner sanctions partial payments for work completed during any specified period, the Contractor upon request by the Commissioner shall furnish a breakdown of the actual quantities and unit prices used in preparing unit bid price for each item in the Proposal. The breakdown must be balanced and not contain prices which are proportionately higher for work to be completed first than for work to be completed later. The Commissioner reserves the right to order such changes as may, in the Commissioner's opinion, be necessary to balance such breakdown.

2.5.10 Time for Completion — Essence of Contract—

The parties hereto specifically understand and agree that the time specified for completion is of the essence of this contract, and the Contractor shall not be entitled to claim performance of this agreement unless the work is satisfactorily completed in every respect within the time agreed to by the parties in this agreement.

2.5.11 Contractor to be Charged for Inspection After Time Allowed for Completion has Expired—

The Contractor shall be charged for inspection provided by the City or by an agent for the City for each and every day inspection is required on all construction projects after the time allowed for completion has expired. This per diem rate for inspection, when provided by the City, shall include the cost of inspection, construction supervision, clerical, and administrative costs, traffic engineering, vacations, pensions, holidays, overtime, and other similar overhead charges. This charge for inspection will be deducted from monies due the Contractor at the completion of the contract. The amount of the per diem charge shall be set forth in the Bureau of Specifications.

An inspector shall be assigned to the project upon notice from the Commissioner to the Contractor to start work. If more than one crew is utilized by the Contractor, as many additional inspectors will be assigned to the work as the Commissioner deems necessary. An additional charge per day after the time allowed for completion shall be made for each such additional inspector. Inspection will be continuous until, in the judgment of the Commissioner, the work is complete. This period of time will include all construction operations, including cleaning of work site. If for any reason a Contractor wishes to suspend operations, a request for permission to do so shall be made in writing to the Commissioner. Such permission will only be granted for conditions beyond the control of the Contractor such as strikes, governmental regulations, severe shortage of building materials, fires, floods, or for other reasons authorized by the Commissioner.

When the official notice requires completion of the contract by a specific calendar date or a specified number of calendar days from date of order to proceed, all

work including cleanup of the work site must be complete by that date. However, upon written request from the Contractor, an extension of time may be granted by the Commissioner due to conditions beyond control of the Contractor such as strikes, governmental regulations, severe shortage of building material, fires, floods, or for other reasons authorized by the Commissioner.

When a portion of the contract is required to be completed by a specific calendar date or within a specified number of calendar days, the per diem charge for inspection will be assessed for each work day beyond that date until the required portion is complete unless an extension of time has been granted.

The decision of the Commissioner shall be considered final in all matters pertaining to the necessity for inspection, the number of inspectors, and the granting of time extension.

2.5.12 Substitution of Materials—

The Contractor may submit plans and specifications for a type of material other than those covered by the contract documents, provided they conform to requirements of the contract documents covering the particular type of material for which a substitute is proposed. In all cases, however, the plans and specifications for the proposed substitution must be approved by the Commissioner in writing.

In the event of such substitution, the Commissioner shall require from the Contractor a credit deduction from the contract amount equal to any saving in material cost resulting from use of the proposed substitute.

The name of the manufacturer and location of the plant shall be furnished together with the proposal for the use of any substitute.

CHAPTER 2.6.0 EXTRA WORK AND CREDITS

2.6.1 Revision of Plans—

In case the Commissioner deems it advisable or necessary in the execution of the work to make any alteration

which will increase or diminish the quantity of labor or material or the expense of the work, such alterations shall not annul or vitiate the contract nor release the Surety. The Contractor shall furnish the necessary labor, material, etc., to complete the work as altered within the time limit originally specified or as extended by the Commissioner. The difference in cost of the work so altered shall be added to or deducted from the amount otherwise due the Contractor, as the case may be, and shall be determined in accordance with the methods specified in this Chapter.

2.6.2 Authority for Altered Work—

No alteration in the work under the contract shall be made without a written order from the Commissioner. No verbal suggestion or other of any employee of the Department of Public Works or of any other person shall be construed as authorizing any claims on the part of the Contractor for extra compensation for labor, materials, or other items pertaining to such work, or for damages or any other expense because of the Contractor's compliance therewith.

Verbal orders and suggestions as to the performance of the work may be given from time to time by representatives of the Commissioner, but when, in the opinion of the Contractor, such orders or suggestions involve extra work for which added compensation should be received; a written order from the Commissioner authorizing such work shall be requested. In the event of any disagreement as to the amount of work involved under any authorized order for extra work, it is specifically agreed by all parties that the decision of the Commissioner shall be binding and conclusive.

2.6.3 Basis of Payment or Credit for Altered Work—

The method of determining the basis of payment or credit resulting from such altered work shall be:

(a) By the UNIT BID PRICE named in the proposal for like items of work.

(b) By a SUPPLEMENTAL SCHEDULE OF PRICES stated by the Contractor in the proposal when such bids are requested and when the Unit Bid Price is not applicable.

(c) By the predetermined FIXED UNIT PRICE contained in the "Supplemental Schedule" included in the Contract documents when the Unit Bid Price is not applicable or when a Supplemental Schedule of Prices bid by the Contractor was not required.

In the event that none of the three foregoing methods are applicable, the Commissioner reserves the right to employ any of the following methods:

(d) By Unit Prices submitted by the Contractor and accepted by the Commissioner.

(e) By a Lump Sum Price submitted by the Contractor and accepted by the Commissioner

(f) By a Cost Plus 15% Basis. Cost is hereby defined as including the actual cost of labor, foremen over labor actually employed upon the extra work (time of foreman if engaged upon supervising other work to be prorated), labor liability insurance, the Contractor's payroll taxes, if any, and materials delivered upon and forming a part of the extra work but excluding all administration and clerical expenses, all supervision and superintendence above foreman, and use and upkeep of small tools, plant and machinery and rent of storage yard. Prevailing rental rates on special tools and equipment and actual cost of special services will be allowed the Contractor without the above specified 15% added thereto.

2.6.4 Claims for "Cost Plus" Extra Work—

Claims for such extra work shall not be considered unless the Contractor presents to the Commissioner's representative on the work an itemized statement in duplicate of the hours of labor, quantities of materials, etc., upon which payment is to be based. The Commissioner's representative shall verify such amounts and shall retain the original for the Commissioner and return the duplicate copy to the Contractor. The verification of such items by the Commissioner's representative shall not in itself be construed as authorization or acceptance of such claims. No claims will be considered until the original bills, receipts, or vouchers have been furnished to the Commissioner by the Contractor.

2.6.5 Time Limit for Filing Claims for Extra Work—

Claims for extra work shall be filed at such intervals as directed by the Commissioner or as designated in the contract documents but in all cases not later than five days after the Date of Completion.

CHAPTER 2.7.0 PROTECTION OF WORK

2.7.1 Protection of Work—

During performance and up to completion date of work, the Contractor shall be under an absolute obligation to protect finished and unfinished work against any damage, loss, or injury, and in the event of such damage, loss or injury, the Contractor shall promptly replace or repair such work, whichever the Commissioner shall determine to be preferable. The performance of any work by City forces, when done in conjunction with work under the contract, shall not relieve the Contractor from full responsibility and liability.

2.7.2 Street Barricades, Signs, and Warning Devices—

The Contractor shall be responsible for the erection and maintenance of all barricades, lights, and signs necessary for public safety and convenience in accordance with the specifications entitled "Minimum Requirements for Warning Devices to be Used for Work Performed in the Public Ways." In general, all hazards within the limits or the work or on detour around the work must be marked with well-painted, well-maintained barricades, reflectors, electric lights, flashers, and warning and directional signs in sufficient quantity and size adequate to protect life and property. These safeguards shall be moved, changed, increased, or removed as required during the progress of the work to meet changing conditions.

2.7.3 Street Barricades and Detour Signs—

Whenever the Contractor shall have received a permit to close any street, alley, or public right of way to travel, the Contractor shall immediately upon the closing of such thoroughfare furnish, erect, and maintain substantial barricades across the streets, alleys, or property affected and shall furnish, post, and maintain detour

signs thereon. Detour signs shall also be posted and maintained at immediately adjacent street and alley intersections for the convenience and guidance of traffic. The barricades and detour signs shall be illuminated by red lights throughout the night, or when visibility is poor, detour signs shall conform to the standard detailed and shown in the specifications.

2.7.4 Flagperson Required—

Whenever the Contractor's operations obstruct or endanger a traffic lane and no marked detour has been provided, the Contractor shall furnish a flagperson to direct traffic through or around the congested area. The Commissioner shall have the right to require additional flagpersons as may be deemed necessary.

2.7.5 Removal of Snow—

The Contractor shall be responsible for immediate removal of snow from those sections of streets which the Contractor has obstructed.

CHAPTER 2.8.0 PROPERTY PROTECTION AND SANITATION

2.8.1 Protection of Work and Property — Emergency—

(a) The Contractor shall at all time safely guard City property from injury or loss in connection with this contract. Contractor shall at all times safely guard and protect the work site and that of adjacent property from damage. The Contractor shall replace or make good any such damage, loss, or injury unless such be caused directly by the City.

(b) In case of some emergency which threatens loss or injury of property and/or safety of life, the Contractor will be allowed to act, without previous instructions from the Commissioner, in a diligent manner. The Contractor shall notify the Commissioner immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted to the Commissioner for approval or disapproval. The Commissioner's determination shall be final and conclusive.

(c) Where the Contractor has not taken action but had notified the Commissioner of an emergency threatening injury to persons or damage to the work or any adjoining property, the Contractor shall act as instructed or authorized by the Commissioner.

2.8.2 Safeguarding Adjacent Buildings—

Prior to commencing an excavation or tunnel in the immediate vicinity of any building or other structure, the safety of which may be endangered thereby, the Contractor shall comply with all requirements of applicable law. The Contractor shall serve the required notice upon the owner of such building or structure or the agent, naming the date of commencement of such work and allotting a reasonably sufficient length of time for the owner to take steps to protect the property. Throughout the course of the work adjacent to such property, the Contractor shall exercise due precaution and care and, at own expense, shall furnish and place such extra timbering, bracing, and sheathing as may be necessary to insure against the loss of ground adjacent to the excavation or tunnel and, when so indicated on the plans or when so ordered in writing as an extra by the Commissioner, shall leave such portions of timbering, bracing, and sheathing in place, as the Commissioner may direct. The Contractor must also take necessary precautions in the work operations to prevent the loss or settlement of such adjacent grounds and avoid the use of equipment which would tend to encourage such settlement or loss of ground.

2.8.3 Property Safeguards—

The Contractor shall safeguard from and be solely responsible for all damage resulting from the work operations to water, gas steam or drain pipes, street and building sewers, building services, catch basins, manholes, conduits, cables, hydrants, valve and stop boxes, light poles, street lighting cables and transformers, traffic signals, traffic and street signs, fire and police alarm boxes, mail boxes, or any other privately or publicly owned existing installation or structure and the right of way structure of any steam or electric railway or railroad. The Contractor shall also safeguard from and be solely responsible for damage to pavements, sidewalks, curbs, gutters, trees, shrubbery, or lawns, except in such

cases where the removal without replacement has been authorized in the contract documents or by the Commissioner. The cost of all safeguarding shall be included in the price bid for work under the contract.

2.8.4 Access to Properties—

During the work the Contractor shall not shut off nor unnecessarily interfere with either pedestrian or vehicular access to property without the consent of the Commissioner.

2.8.5 Work in Private Right of Way—

Whenever the work is to be prosecuted through private property for which the City has obtained a license or an easement, the Contractor shall abide fully with the terms of the license or the easement, a copy of which is on file in the Department of Public Works.

2.8.6 Statement from Easement Grantors—

Before final payment will be made, the Contractor shall obtain and submit to the Commissioner a statement from the parties granting the license or easement, which statement shall be in the following form:

Date _____

Commissioner of Public Works,
City of Milwaukee:

The property owned by the undersigned has been left in a satisfactory condition, following the recent completion of construction work through such property, as described in the license or easement agreement permitting such work.

_____	_____
(Witness)	(Witness)
_____ by	_____
(Witness)	(Title)

2.8.7 Failure to Secure Statement—

In case the Contractor is unable to secure the above statement, the Contractor shall inform the Commissioner of the reasons for failure to do so. The Commissioner

or the Commissioner's representative shall then examine the site, and the Commissioner shall direct the Contractor to complete any work that may be necessary to satisfy the terms of the license or easement. Should the Contractor refuse to do the work, the Commissioner reserves the right to have it done by contract or force account and deduct the cost of same from monies due the Contractor, or the Commissioner may require the Contractor to furnish a bond in a sum satisfactory to the Commissioner to cover any legal claims for damages. When the Commissioner is satisfied that the work has been completed in compliance with the contract documents and the terms of the license or easement, the Commissioner reserves the right to waive the requirement of obtaining the statement, when the Contractor's failure to obtain such statement is due to the grantor's refusal to sign and this refusal is not based upon any legitimate claims that the Contractor has failed to fulfill the terms of the license or easement or when the Contractor is unable to find or undue hardship would be imposed to solicit the grantors.

2.8.8 Maintenance of Crosswalks and Gutters—

Suitable pedestrian crossings, at least four feet in width, shall be provided and maintained by the Contractor as directed by the Commissioner. Gutters must not be obstructed at any time, and where it is necessary to cover them, a continuous pipe or timber drain ample to carry off the storm waters shall first be laid along the gutter, and such pipe or drain shall be kept open and free from obstructions.

2.8.9 Sanitary Regulations—

The Contractor shall construct and maintain properly sheltered sanitary conveniences for the employees, and their use must be strictly enforced. When permission is granted to use the manholes of designated sewers for sanitary outlets, such manholes must be flushed and cleaned periodically and thoroughly cleaned when no longer in use.

2.8.10 Drainage—

Drainage must not be obstructed at any time. When necessary, a continuous pipe or timber drain of ample capacity shall be laid to carry off the storm water. Such

pipe or drain shall be kept open and free of obstructions.

All storm or ground water, which is to be removed from the site of the work, must be conveyed to an inlet of a storm or combined sewer, or when so approved by the Commissioner to some other point of disposal. All sanitary sewage must be conveyed by closed pipe or hose to an inlet of a sanitary or combined sewer, or when so approved by the Commissioner, to some other point of disposal. Proper precautions shall be taken to prevent excessive quantities of clay, sand, or silt from entering existing sewers. All existing structures which are disturbed must be restored to a condition at least equal to their original condition and to the satisfaction of the Commissioner.

2.8.11 Access to Public and Private Underground Structures and Appurtenances—

Free access must always be maintained to fire hydrants, fire alarm and police call boxes, water and gas gate valves, catch basins, sewer, water, Bureau of Traffic Engineering and Electrical Services, utilities, manholes, and appurtenances. Whenever free access to any such structure shall have been obstructed or interfered with during the progress of the work, the Contractor shall immediately remove, at the Contractor's own expense, such obstruction or interference.

2.8.12 Water Line Connections to Hydrants—

The piping and fittings which the Contractor employs for connecting a water supply line to a City hydrant shall be equipped with a valve to be used in place of the regular hydrant valve which shall remain fully opened during usage. The fitting and valve assembly shall be watertight.

2.8.13 Traffic—

The Contractor shall maintain vehicular traffic as specified in the contract documents or as otherwise directed by the Commissioner.

2.8.14 Emergency Maintenance and Protection—

In the event it becomes necessary for the City to per-

form emergency maintenance and protection, which is the responsibility of the Contractor under the contract documents, the cost of such work shall be billed to the Contractor and deducted from the final payment if not paid.

CHAPTER 2.9.0 LEGAL RELATIONS

2.9.1 Laws and Regulations—

The Contractor, the Contractor's agents, and employees, shall at all times observe and comply with all Federal laws, rules and regulations, statutes, codes, rules and regulations of the State of Wisconsin, and all applicable charter provisions, codes, regulations, and ordinances of the City of Milwaukee, all amendments thereto, and all the provisions of the contract documents, which in any manner affect the conduct of the work and all such orders or decrees as exist at the present and which may be enacted later of bodies or tribunals having jurisdiction or authority over the work. The Contractor shall protect and save harmless the City, its officers, and representatives, against any claim or liability arising from the violation of any such law, ordinance, code, rule, regulation, or order.

2.9.2 Assignment and Subletting—

Any subcontracting of this agreement is mutually recognized by all parties only to the extent of its approval and acceptance by the Commissioner at the time of the award of this contract. The Contractor shall not subsequently assign this contract or any interest therein, nor subcontract the work or any part thereof, without written consent of the Commissioner having first been obtained. If the Contractor submits subsequent written request to the Commissioner for substitution(s) of listed subcontractor(s), the Contractor shall give the Commissioner written assurance that the Contractor will save the City harmless from any damages which may arise from litigation between the original subcontractor(s) and the Contractor as a result of such substitutions. The decision of the Commissioner shall be final in determining consent for said substitution(s). It is incumbent upon the Contractor to notify the Surety of such consent granted by the Commissioner for said substitution(s).

If the Contractor shall so assign or subcontract without such consent, the Commissioner shall have the right to rescind this contract and to declare the same null and void or to relet the work to some other competent party, thereupon adjusting and determining the damages to the City arising thereby, and the Contractor shall be liable to the City for such damages as the Commissioner shall so adjust and determine, which adjustment and determination thereof, shall be final and conclusive on the parties thereto.

The Contractor assumes full liability for all acts and omissions of any subcontractor or of anyone employed directly or indirectly by either said Contractor or any subcontractor, and this liability shall be in addition to any other legal liability of the Contractor. Neither the approval nor endorsement of the Commissioner nor anything contained in the contract documents shall be construed as creating any contractual relationship between any subcontractor and the City.

Consent to the assignment or subletting of this contract or of any part thereof or any alterations which may be made in the terms of this contract or in the work to be done under it or the granting of any extension of time for the performance of the contract or any other forebearance on the part of either the Commissioner or Contractor to the other shall not in any way release the Contractor or Surety or their heirs, executors, administrators, successors, or assigns from their liability hereunder.

2.9.3 Patents and Trade Secrets—

The Contractor shall hold and save the City and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for or on account of any patented or unpatented invention process, article, or appliance manufactured or used in the performance of the contract, including its use by the City, unless otherwise specifically stipulated in the contract documents.

If the Contractor uses any design, device, or materials covered by letters, patent, or copyright, the Contractor shall provide for such use by suitable agreement with the owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood

that, without exception, the contract prices shall include all royalties or costs arising from the use of such design, device, or materials, in any way involved in the work. The Contractor and/or Contractor's Sureties shall indemnify and save harmless the City from any and all claims for infringement by reasons of the use of such patented or copyrighted design, device, or materials or any trademark or copyright in connection with work agreed to be performed under this contract and shall indemnify the City for any cost, expense, or damage which it may be obliged to pay by reason of such infringement at any time during the prosecution of the work or after the completion of the work.

License and/or Royalty Fees for the use of a process which is authorized by the City must be reasonable and paid by the Contractor to the holder of the patent or authorized licensee.

2.9.4 Liens and Taxes—

Any and all taxes and license or permit fees imposed by the Federal, State, and local municipalities are the sole responsibility of the Contractor. Any and all liens or claims of damages which may be chargeable to the Contractor are the sole responsibility of the Contractor. Commissioner reserves the right to withhold a sufficient amount from the contract payment to indemnify the City against such liens or claims of damages.

No materials or supplies for the work shall be purchased by the Contractor or by any subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. The Contractor warrants that the Contractor has good title to all materials and supplies used in the work, free from all liens, claims, or encumbrances.

2.9.5 Sales Tax—

The City is exempt from Wisconsin Use and Sales Tax. Bidders, therefore, shall not add sales tax to their proposals when bidding to the City but shall include in their lump sum bids only the sales tax they will be required to pay directly as a consumer, when obtaining materials, etc., to fulfill the contract requirements should they be the successful bidder.

2.9.6 Protection Against Liability—

Contractor covenants and agrees that Contractor shall save and indemnify and keep harmless the City against all liability, judgments, costs, and expenses, which may in anywise come against the City in consequence of the granting of the contract, or which in anywise result from the carelessness or neglect of the Contractor or the agents, employees, or workers of the Contractor in any respect whatever, and in every such case where judgment is recovered against the City by reason of the carelessness or negligence of the Contractor or the Contractor's agents, employees or workers and if notice has been given of the pendency of such suit within 20 days after the commencement thereof, such judgments shall be conclusive against the Contractor, not only as to the amount of damages, but as to Contractor's liability to the City.

2.9.7 Liability and Insurance—

The Contractor shall be responsible for and shall save the City harmless from all liability for damages occasioned by the digging up, use or occupancy of the street, alley, highway, public grounds, and private grounds, or which may result therefrom, or which may result in any way from the negligence or carelessness of the Contractor, the Contractor's agents, employees, workers, by reason of the elements, unforeseen or unusual difficulties, obstructions, or obstacles encountered in the prosecution of the work, and they shall indemnify the City for and save it harmless from all claims and liabilities, actions, causes of action, and liens for materials furnished or labor performed in the construction or execution of the work and from all costs, charges, and expenses incurred in defending such suits or actions and from and against all claims and liabilities for injury or damage to persons or property emanating from defective or careless work methods, or from and against all claims or liabilities for royalties, license fees, actions, suits, charges, and expenses or damage from infringement for reason of the use of any invention or improvement in tools, equipment, or plant or any process, device or combination of devices used in the construction of the work.

Contractor is to effect and maintain, during the entire term of the work and in conformance with the terms of the contract, primary insurance protecting both the

Contractor and the City of Milwaukee in the types and amounts as follows unless otherwise specified:

(a) WORKER'S COMPENSATION INSURANCE — Contractor and Subcontractor shall furnish to the City prior to start of work a certificate of insurance with ten (10) day notice of cancellation as proof that the Contractor and all Subcontractors carry statutory coverage of Worker's Compensation Insurance for all persons performing any work or services under the contract, as required by the Workmen's Compensation Act of the State of Wisconsin and all acts amendatory thereof and supplementary thereto. A separate insurance certificate need not be furnished if the Contractor or Subcontractor has filed a certificate currently in effect. No Contractor or Subcontractor shall perform any work under the contract after expiration or cancellation of the insurance certificate on file with the City unless and until a new certificate of insurance is placed on file as proof of the required statutory coverage.

(b) COMPREHENSIVE GENERAL LIABILITY, CONTRACTUAL COVERAGE, AND PROPERTY DAMAGE INSURANCE — Coverage to include premises/operation coverage, owner's contractors protective coverages, products/completed operations (to extend for at least two years after the acceptance of the work by the City), blanket explosion, collapse and underground coverage, all subject to the following minimum limits:

Bodily Injury ..... $1,000,000 per occurrence
$1,000,000 aggregate

Property Damage ..... $500,000 per occurrence
$500,000 aggregate

(c) COMPREHENSIVE AUTOMOBILE LIABILITY AND PROPERTY DAMAGE — Operations of owner, hired, and non-owned motor vehicles.

Bodily Injury ..... $500,000 per person
$1,000,000 per occurrence

Property Damage ..... $500,000 per occurrence

(d) BLANKET CONTRACTUAL COVERAGE — or a specific endorsement designating this coverage: $1,000,000.

The City of Milwaukee shall be named as an additional insured in respect to liability coverage and will be given such notice as required by law in advance of cancellation, non-renewal, or material change in any coverage.

Prior to the commencement of activities, the Contractor and/or any approved subcontractor shall file with the City a certificate of insurance evidencing the specified coverage including the additional insured and cancellation endorsements.

2.9.8 Performance Bond and Payment Bond—

Contractor is to submit to the Commissioner prior to or at the time Contractor has executed the contract, a performance bond and a payment bond in an amount to at least equal 100% of the contract price and executed by a Surety company authorized to do business in the State of Wisconsin for the payment and faithful performance of the contract. The performance bond and the payment bond shall be submitted as separate instruments. Such bonds shall be approved as to their sufficiency by the City Comptroller and as to form and execution by the City Attorney. The performance bond shall also cover all work required under the guarantee provisions of the contract.

2.9.9 Unforeseen Delay—

If the City is prohibited or enjoined from proceeding with the work or from authorizing its prosecution, either before or after its commencement, by reason of any litigation or otherwise, the Contractor shall not be entitled to any damages by reasons of the delays thereby caused, except for the actual cost of protection of such work as the Contractor may have underway for the cost of removal and replacement of such tools, plant, and materials, as the Contractor may have delivered upon the work site, and such cost is to be determined by the Commissioner. The time of completion may be extended for such time, as in the judgment of the Commissioner, shall be equal to the aggregate delay.

2.9.10 Default, Neglect, or Delay Shall Not Render the City Liable—

The default, neglect, or delay of any other contrac-

tors, or the extension of time to any of them by the City for the completion of their work shall not render the City liable to the Contractor or its Surety nor relieve them or either of them in any manner or sum whatsoever.

2.9.11 Collusive Agreements — Prohibited—

Each bidder submitting a bid for any portion of the work contemplated by the documents on which bidding is based shall execute, and attach thereto, an affidavit substantially in the form provided to the effect that the bidder has not entered into a collusive agreement with any other person, firm, or corporation in regard to any bid submitted and also include therein compliance with Sec. 3.29, Milwaukee City Charter, such forms of affidavit being on file in the office of the Commissioner.

Before executing any subcontract, the successful bidder shall submit the name of any proposed subcontractor for prior approval and a non-collusive affidavit substantially in the form provided.

2.9.12 Progress Payments—

If the Contractor shall proceed properly and with diligence to perform and complete this contract, the Commissioner may, from time to time as the work progresses, grant to the Contractor an estimate of the amount already earned, reserving ten percent thereof, except that at any time after fifty percent of the work is completed and the Commissioner finds that satisfactory progress is being made, remaining progress estimates may be paid in full, which shall entitle the holder thereof to receive the amount due thereon, when the conditions, if any, annexed to such estimate shall have been complied with, and that estimates may be granted by the Commissioner for any fabricated or manufactured materials and components specified, previously paid for the Contractor and delivered to the work site or properly stored and suitable for incorporation in the work embraced in the contract. The granting of any such estimate shall not be construed as an acceptance of the work or any portion thereof.

2.9.13 Final Payment—

Upon the completion of the work by the Contractor

pursuant to the terms of this contract and according to the contract documents and the true intent and meaning of this contract and after the acceptance of the work by the Commissioner, the City shall pay the Contractor, subject to any retainer or guarantee provisions in the contract documents, any balance then remaining due and payable by the terms of this contract; such final payment, however, to be made not sooner than 20 days following the acceptance of the work in accordance with Sec. 7.32, 3.17, and 3.18, Milwaukee City Charter.

All monies paid by the City to the Contractor shall be and constitute a trust fund, in the hands of the Contractor, to the amount of all claims due and to become due or owing from the Contractor for lienable labor and materials until all such claim have been paid. The using of such monies by the Contractor for any other purpose until all such claims have been paid is, as declared by Section 779.02(5), Wisconsin Statutes, punishable as therein provided by law.

2.9.14 Final Payment to Terminate Liability of City—

The acceptance by the Contractor of the "Final Payments" provided for in the contract shall operate as, and shall be, a release to the City and its representatives from all claims by the Contractor for anything done or furnished for or relating to the work or for any act or neglect of the City or of any person relating to or affecting the work.

2.9.15 Time for Completion—

The time specified for the completion of the work is of the essence of this contract, and the Contractor shall not be entitled to claim performance of this contract unless the work is satisfactorily completed in every respect within the time herein specified.

2.9.16 Contractor City Relationship—

The relation of the Contractor to the City is and shall be that of an independent Contractor.

2.9.17 Special Conditions Federally-Aided Projects—

Any special conditions relating to contracts involving the Economic Development Administration (EDA), the

Department of Housing and Urban Development (HUD), or federally assisted projects are subject to the special conditions attached hereto, which special conditions insofar as inconsistent with the provisions and general conditions heretofore stated shall be controlling.

CITY OF MILWAUKEE

DEPARTMENT OF PUBLIC WORKS

BUREAU OF ENGINEERS

WATER MAIN INSTALLATION SPECIFICATIONS

Part 3 — Bureau Requirements
Part 4 — Materials
Part 5 — Construction
Part 6 — Specification Drawings

19 **87**

MILWAUKEE, WISCONSIN

January 2, 1987

PART 3

BUREAU REQUIREMENTS

CHAPTER 3.1.0 INSTALLATION SPECIFICATIONS — GENERAL

3.1.1 Water Main Installation Specifications

These specifications govern the installation of 4″ thru 60″ diameter water mains, and 3″ thru 12″ diameter branch service piping.

3.1.2 Standard Specifications

Standard specifications, Codes and Regulations, including addenda, to which these specifications refer are as follows:

American Association of State Highway and Transportation Officials (A.A.S.H.T.O.)

American National Standard Institute (A.N.S.I.)

American Concrete Institute

American Society for Testing and Materials Specifications (A.S.T.M.)

American Water Works Association Standards (A.W.W.A.)

Occupational Safety and Health Act (O.S.H.A.)

Rules and Regulations Governing Water Service, City of Milwaukee

Sewer and Building Service Specifications, City of Milwaukee

Street Construction Specifications, City of Milwaukee

Street and Sewer Maintenance Specifications, City of Milwaukee

Traffic Control for Construction and Maintenance Work, City of Milwaukee

Water Engineering Division Material Specifications, (W.E.D.)

Water Service Piping Specifications, City of Milwaukee

Wisconsin Administrative Code

Wisconsin Department of Natural Resources

CHAPTER 3.2.0 DEFINITIONS

3.2.1 Definition of Terms

Where any of the following listed terms appear in the contract documents, they shall be defined as set forth below. Also see Chapter 2.1.0.

3.2.2 Bureau of Engineers

The Bureau of Engineers of the Department of Public Works of the City of Milwaukee.

3.2.3 City

The City of Milwaukee, a municipal corporation of the State of Wisconsin, located in the County of Milwaukee.

3.2.4 City Engineer

The City Engineer of the City of Milwaukee or his duly authorized representative.

3.2.5 Cistern — Fire Department

A masonry chamber filled by City water formerly used by the Fire Department as a water source for fighting fires.

The installation includes all piping from the main to the cistern, the cistern and its drain. The components of a cistern usually consist of a tee or tapping valve and sleeve, pipe, gate valve, valve box, cistern valve, masonry cistern with a special manhole frame and cover, cistern drain valve and drain pipe to the sewer.

3.2.6 Commissioner

The Commissioner of Public Works (CPW) of the City of Milwaukee or his duly authorized representative.

3.2.7 Construction Engineer

The Construction Engineer of the Sewer and Water Section of the Construction Division.

3.2.8 Distribution System

The network of water mains conveying water from pumping stations, reservoirs and tanks to the points of consumer supply. Mains up to and including 16″ diameter are designated as "distribution" mains. Mains 20″ diameter and larger are designated as "feeder" mains.

3.2.9 Division

Water Engineering Division or Construction division, of the Bureau of Engineers. Plans and specifications are prepared and materials are inspected by the Water Engineering Division; Installation Inspection and Construction Supervision are performed by the Construction Division.

3.2.10 Drawings

The Contract Drawings and the Drawing(s) which are included in these specifications which pertain to work covered by the contract. See Part 6 for the Specification Drawings.

3.2.11 Engineer in Charge, Construction Division

The Engineer in Charge of the Construction Division of the Bureau of Engineers.

3.2.12 Engineer in Charge, Water Engineering Division

The Engineer in charge of the Water Engineering Division of the Bureau of Engineers.

3.2.13 Field Engineers

The Field Engineers of the Public Ways Engineering Division of the Bureau of Engineers, assigned to the

project to provide primary line and grade.

3.2.14 Fixed Prices

The Fixed Unit Prices contained in the contract under the "Supplemental Schedule" of Fixed Prices for extra work and for credits referred to in chapter 2.6.0.

3.2.15 Flow Line of Pipe

The inside bottom at the vertical centerline of the water pipe, or invert of a pipe.

3.2.16 His

Where referred to herein, the term "his" does not refer to the male gender exclusively but includes male or female in the context of this specification.

3.2.17 Hydrant Branch

The piping from the main to the hydrant, the hydrant and its drain system. The components of a hydrant branch, usually are a tee, pipe, valve, valve box, hydrant, a drainage bed of crushed stone and thrust restraint.

3.2.18 Inspector

The authorized representative of the Commissioner assigned to make detailed inspection of any or all work and/or materials in accordance with the plans and specifications.

3.2.19 Laid Length

The measured distance along the center line of the installed water main or branch.

3.2.20 Plan(s)

The contract plan(s) and revisions thereof, pertaining to work covered by the contract.

3.2.21 Service Piping

The piping from the main to and including the water meter outlet valve. Service piping is further defined

depending on size and arrangement as either Tap service or Branch service piping. The components of Tap service piping are a corporation stop with or without a tapping saddle, copper tubing or lead pipe, curb stop, service box, meter inlet valve, meter with or without a meter horn and a meter outlet valve. The components of Branch service piping are a tapping sleeve and valve or a branch tee and valve, valve box, pipe, special fittings, meter, meter inlet and outlet valves and test connections complete with valves. The installation shall conform to "The Water Service Piping Specifications" and the "Rules and Regulations Governing Water Service."

3.2.22 Shop Drawings

Shop drawings include fabrication, assembly, shop and other drawings required to be furnished by the contractor; all drawings showing essential details of any change in design or construction proposed by the contractor; and all drawings of equipment and devices offered by the contractor.

3.2.23 Special Layout Engineer

The Special Layout Engineer of the Department of Public Works of the City of Milwaukee.

3.2.24 Water Main and Appurtenances

The water main includes the pipe, special castings or fittings, valves, valve boxes and manholes installed as an integral part of the distribution system. Appurtenances include hydrants, branches, and water service piping.

3.2.25 Wisconsin Administrative Code

The latest revision of the rules of the Department of Industry, Labor and Human Relations, Industrial Safety and Building Division on Trench Excavation and Tunnel Construction.

CHAPTER 3.3.0 ABBREVIATIONS

3.3.1 Abbreviations

The following abbreviations are used on plans and in the contract documents.

ABN	Abandon
A.C.	Asbestos — Cement Pipe
AT 8″ x 6″	Anchoring Tee 8″ x 6″ diameter 2 bell with anchoring spigot outlet
Asph.	Asphalt
AV-1″ or 2″	Air Vent (1″ or 2″ diameter)
AV-MH	Air Vent in masonry manhole (No Manhole Pipe)
AWM	Abandon with main
2B, 3B or 4B	All Bell Pipe Fitting
Br	Branch
BS	Bell and Spigot Pipe or Fitting
BS6-10.5′	Bell and spigot Pipe, 6″ dia. 10.5 foot length
B6-90 (2B)	Bend, 6″ diameter, 90 degree, Bell and Bell
BO	Blow-off
BOMHP 30x8 — (BS)	Blow-off Manhole Pipe, 8″ dia. Blow-off on a 30″ manhole pipe, bell and spigot
BTE & ES	Bureau of Traffic Engineering and Electrical Services
BFV 42 MJ	Butterfly Valve, 42″ diameter, Mechanical Joint
BFV 16 MJ (OPE)	Butterfly Valve, 16″ in dia., Mechanical Joint, Operator East of Main
C6	Cap, 6″ in dia.
C8 W/2″ AV	Cap, 8″ in dia. with 2″ air vent
C.I.	Cast Iron — 'gray' iron
C/L	Center Line
CCS	Cut In Curb Stop
Comp.	Computed
C.W.M.	Concrete water main
Conn.	Connect
Comb.	Combined Sewer
Culv.	Culvert
Conc.	Concrete
C.W.	Concrete Walk
C.O.S.	Connect Original Service
X 8 X 6 (4B)	Cross, (4 way) 8″ dia. by 6″ dia. (Bell, Bell, Bell and Bell)
D.B.	Disconnect Branch
D.I.	Ductile Iron
D.S.	Disconnect Service
E/L	East Street Line

Elec.	Electric
ELEV.	Elevation
E.S.	Extend Service
F.C.	Fire Cistern
F.L.	Flow Line
F & P	Fire and Police (BTE & ES)
4200	4200 Block (Starts at heavy line)
G.V.	Gate Valve
H (7.0)	Hydrant, Mechanical Joint, 7′-0″ bury length, (or 6′-6″, 7′-6″, 8′-0″, or 8′-6″)
H/rem	Hydrant Remove
H/rem (major)	Hydrant, Remove, major
H/rem (minor)	Hydrant, Remove, minor
HPFM	High Pressure Fire Main
LJ	Lead Joint
L.L.	Laid Length
Lt. J	Sulphur (Leadite) Joint
Lug'd.	Lugged
M.I.S.	Metropolitan Intercepting Sewer
MH	Manhole
MHP (BS)	Manhole Pipe (Bell and Spigot)
MJ	Mechanical Joint
M.W.W.	Milwaukee Water Works
N/L	North Street Line
OFS 6 x 18″ (BS) (MJ)	Offset Fitting 6″ dia., 18″ offset (Bell and Spigot) (Mechanical Joint)
(V) or (H)	Vertical or horizontal
PVMT.	Pavement
P.C.	Point of Curvature
P.I.	Point of Intersection
P.T.	Point of Tangency to a curve
P.O.	Push-on Joint (Rubber)
Prop. Gr.	Proposed Grade
PVC	Polyvinyl Chloride Pipe
P6	Plug, 6″ diameter
Pito	Pitometer Manhole
Red 8x6 (SEB)	Reducer, 8″ dia. by 6″ dia. (Small end bell with large end spigot)
R.C.S.	Relocate Curb Stop
R.J.	Push On Rubber Joint unless otherwise noted

Rem.	Remove
R.P.	Riser Pipe
R.P.M.H.	Riser Pipe Manhole
R.S.B.	Roadway Service Box
R.O.S.	Replace Original Service
R & S	Rubber & Steel Joint
SS 8 — 2'-0"	Spigot & Spigot Pipe, 8" dia., 2'-0" long
SL 12	Sleeve 12" diameter
SL8 (DP)	Sleeve 8" in diameter, dual purpose or size for connecting pipe of different outside diameters
S/L	South Street Line
San.	Sanitary Sewer
Sto.	Storm Sewer
Tar. Mac.	Tar Macadam
Tel.	Telephone
T8x6 (3B) 45.50	Tee, 8" dia. by 6" dia. (Bell, Bell & Bell), Install centerline of tee at elevation of 45.50
Temp.	Temporary
V.C.	Vertical Curve
VB-DD/W Ext.	Valve Box, DD length with extension
V6	Gate Valve, 6" dia.
V/abn	Valve abandon
V/rem	Valve remove
W.E.	Water Easement
W/L	West Street Line
W.M. (A.C.)	Water Main — Asbestos Cement
W.M.	Water Main — Grey Cast Iron
W.M. (conc.)	Water Main — Concrete
W.M. (D.I.)	Water Main — Ductile Iron
W.M. (P.V.C.)	Water Main — Polyvinyl Chloride
W.U.	Western Union

CHAPTER 3.4.0 CONTRACTOR REQUESTS, SPECIAL NOTICES AND PERMITS

3.4.1 Request for Primary Line and Grade

The Contractor shall notify the Special Layout Engineer of the Department of Public Works at least 3 work-

ing days prior to the date when work will be started, during which time the primary line and grade will be staked out. As work progresses, the City Engineer shall be requested to furnish additional line and grade stakes not less than 3 days and not more than 10 days before they are required. The Contractor shall be responsible for the protection and preservation of such stakes.

3.4.2 Request for Inspector

The Contractor shall notify the Construction Division Office that an inspector is required at least 2 working days before commencing work, or adding another crew after construction has started. See Section 3.4.13.

3.4.3 Request for Material Furnished by City

The Contractor shall notify the Construction Division Office and Stores Division at least 5 days before water main material furnished by the City is required.

3.4.4 Request for Water Distribution Division Crew

The Contractor shall notify the Construction Division Office 48 hours prior to the time that services of the Distribution Division are required.

3.4.5 Request for Water Service Taps

When taps for water service are required, the contractor shall notify the Water Distribution Division of the need for a tapping crew 48 hours prior to the time the taps are required.

3.4.6 Permit for County Parkways and Parks

The Contractor shall obtain a Right-of-Entry Permit from the Milwaukee County Park Commission prior to the start of construction work to be done in Milwaukee County Parkways or Parks.

3.4.7 Permit and Notice for State Highways

The Water Engineering Division will obtain a Permit to excavate from the Wisconsin Department of Transportation — Division of Highways, for any work to be done within the limits of State trunk highways.

The Contractor shall give written notice to the State of Wisconsin Dept. of Transportation, District 2, five (5) days prior to starting work. The Construction Division shall receive a copy of the notice prior to start of the work in a State Highway.

3.4.8 Permit and Notice of County Highways

The Contractor shall obtain a Permit from the Milwaukee County Department of Public Works for any work to be done within the limits of County highways. He shall give written notice to the County Highways Department 5 days prior to starting work. The contractor shall furnish a copy of the notice to the Construction Division prior to start of the work in a County Highway.

3.4.9 Notice for Arterial Street or Highway

The Contractor shall give written notice to the City Bureau of Traffic Engineering at least 5 days before excavating in any Arterial Street or Highway. The Construction Division shall receive a copy of the notice before any equipment or materials are moved into the Arterial Street or Highway.

3.4.10 Notice to Milwaukee County Transit System

The Contractor shall give written notice to the Milwaukee County Transit System at least 3 days before commencing work in a street which is a bus route. The Construction Division shall receive a copy of the notice prior to the start of any work in such a street.

3.4.11 Notice to Other Utilities, Cable TV, and City Departments

The Contractor shall give written notice at least 3 days before starting work to any utility, Cable TV or City department not previously covered in this chapter whose operation or equipment could be affected by the Contractor's operation. Diggers Hot Line may be utilized by the contractor for notification. If the contractor does not start within ten days of notification, a new notification shall be required.

3.4.12 Permits to be Presented

The Contractor shall present all permits required to

the Commissioner's representative before commencing work on a job site. See Section 2.3.0.

3.4.13 Notice to W.E.D. for Material Inspection

The Contractor shall notify the Water Engineering Division Office for inspection of materials at least 4 working days prior to starting work. See Section 3.4.2.

CHAPTER 3.5.0 GENERAL WORK PROVISIONS

3.5.1 Traffic Control and Closing of Streets

Traffic control and street closings are subject to any specific traffic requirements indicated on the plans, or by the Commissioner.

3.5.2 Access to Properties

The Contractor shall not shut off pedestrian or vehicular access to property without the consent of the Commissioner nor unnecessarily interfere with such access.

3.5.3 Interference of Underground Structures

When an underground structure interferes with the work to such an extent that an alteration of the plans is required which results in a change in costs, the Commissioner will issue a written order for the alteration required. The basis of payment or credit for such altered work is described in Chapter 2.6.0.

3.5.4 Support of Underground Structures

Whenever the excavation undermines structures such as sewers, ducts, conduits or pipes, such structures shall be supported temporarily by slinging from beams at the surface unless another method is approved. After the excavation and installation are complete, any sewer or water main structure is to be permanently supported by means of a wall made of "Backfill Concrete." The width of the wall shall equal the outside diameter of the bell of the pipe to be supported. The top of the wall shall be curved to permit placing of a 3-inch bedding between the wall and the pipe. With the approval of the Com-

missioner, a reinforced concrete beam, conforming to Drawing No. 2, may be substituted for the supporting wall. Any other method of support must be approved by the Commissioner prior to installation.

The Contractor shall support any other pipe, conduit or underground structure crossing the trench in a manner satisfactory to the Commissioner and to the owner of such underground structure.

3.5.5 Removal of Surface Obstructions

The Contractor shall remove, at his own expense, all obstructions such as mounds of dirt, stone, or debris located in an open street, public way, or easement. Obstructions such as street signs, small culverts and end walls, advertising signs, mail boxes, and guard posts, etc. located in an open street or easement may be removed provided they are promptly replaced to their original condition.

The Contractor shall not remove or trim trees or shrubs located in a private property or easement without the express permission of the property owner. In an open street he may remove only those trees or shrubs which are located within the trench limits as defined in Section 5.1.4. No other trees or shrubs shall be removed unless specifically allowed in the contract documents. Trimming or repairing of trees shall be done in accordance with current Bureau of Forestry procedures. See Section 3.5.21.

3.5.6 Sawing and Removal

The Contractor shall saw all concrete or asphalt pavement to a minimum depth of three inches prior to breaking and removing. Macadam pavements shall be sawed, cut with spades, wheel cutter, or other approved method to a minimum depth of three inches before being removed. Concrete pavement shall be broken (after sawing) with jack hammers or ramtype breakers prior to removal.

On pavements consisting of asphalt on a concrete base, the Commissioner reserves the right to order more asphalt stripped by saw-cutting an additional 3″ beyond the edge of the concrete base to be removed after sawing.

3.5.7 Cutting Double Seal Pavement

The Contractor shall cut double seal bituminous pavements along the edges of the excavation prior to removal in order to avoid ragged edges or excessive removal.

3.5.8 Breaking Pavement

The Contractor may use a drop weight only when such usage does not become a nuisance or a source of danger to underground structures and adjacent properties. Before employing a drop weight, the Contractor shall make sure that there is no nearby underground structure that would be injured by its use and shall be solely responsible for any damage caused thereby. The Commissioner reserves the right to order the discontinuance of the use of such drop weight at any time.

The use of hydraulic or similar type of machinery for breaking pavements must be approved by the Commissioner.

3.5.9 Primary Line and Grade

The Field Engineers shall establish primary line and grade.

In open cut construction, line and grade stakes will be set parallel to the proposed water main and offset in a manner that will best serve the Contractor's work operations. The Field Engineers will set these stakes at frequent intervals and opposite each valve or fitting and at each change in line or grade.

In tunnel construction, the Field Engineers will set line and grade stakes directly above the line of the proposed water main. Following construction of a work shaft, they will transfer the line and grade down the shaft and into the tunnel headings, and thereafter, throughout the construction of the tunnel, project them through the length of each heading.

The Contractor shall render whatever assistance may be required by the Field Engineers and shall arrange the work operation in such manner as to avoid interference with the establishment of line and grade. The contractor shall check the accuracy of line and grade stakes,

or marks, by means of visual and measured checks and be responsible for the protection and preservation of them.

3.5.10 Construction Line and Grade Responsibility

The Contractor bears sole responsibility for the correct transferal of all construction lines and grades from the primary line and grade as established by the Field Engineers and for the correct alignment and grade of the finished structure.

3.5.11 Time Allowed for Completion of Work

Also See Section 2.1.21 of the General Requirements.

After the work has been completed and all of the contract requirements have been met, the date of completion will be certified by the Commissioner.

The amount of the per diem charge for inspection as referred to in Section 2.5.11 shall be $210.00.

Contract requirements to be completed prior to the assignment of the Date of Completion shall include the obtaining of safe water samples. Time on the contract shall be suspended during the period needed to obtain these samples if other work on the contract is not taking place concurrently. If further work is to be performed after the safe water sample has been obtained, time shall be resumed and continue to run on a normal basis.

On a contract with a specified completion date, the Commissioner may extend the date to compensate for the delay necessary to obtain safe water samples. This will apply only if no other work has or could have been performed during this period.

3.5.12 Guarantee of Work and Materials

The Contractor shall guarantee all work, including materials, for a period of two years from the date of completion.

All repairs found necessary within this period shall be made at the Contractor's expense, except as stated in Section 4.3.3. Also see Section 2.5.8.

3.5.13 Civic Improvements Signs

A sign identifying the work under contract as being a City of Milwaukee project shall be placed at each end of all projects in locations designated by the Commissioner. These signs with standards shall be furnished by and remain the property of the Contractor. They shall be constructed and painted in accordance with plans and specifications on file with the City Engineer. All signs shall be maintained and kept in first class condition.

3.5.14 Housing and Telephone for City Inspectors

The Contractor shall provide and maintain throughout the contract the following facilities for the use of the Inspector or Inspectors assigned to the work:

A temporary, clean, well constructed, water tight office (which may be a shanty or one end of a shanty blocked off for the exclusive use of the Inspector and with a separate outside entrance) having approximately 65 square feet of floor area and headroom of 6.5 feet minimum, having suitable windows, a plan table or shelf with a minimum depth of 2 feet and area of 10 square feet, two chairs or a bench, and controlled gas heating facilities with outside vent. The heating unit shall not be located adjacent to the exit. If work is to be done after dark, electric lighting shall be provided. The Contractor's name and telephone number shall be painted on the outside in letters at least 4 inches high.

The office shall be located at the work site and shall be maintained within 600 feet of the principal work operations. Upon completion of the work, it shall be removed from the work site.

On all contracts totaling $150,000 or more, a centrally located separate Inspector's shanty having a free telephone shall be provided during the length of the contract.

3.5.15 Barricades, Signs and Warning Devices

The Contractor shall place barricades in front of and around all excavations, obstructions or construction areas so as to clearly define such areas to pedestrians and drivers of vehicles. Barricades shall be placed as close to the excavation or obstruction as practical and

shall be so placed that each road hazard is properly guarded without blocking more of the active traffic lanes than is absolutely necessary and as may be designated in the special provisions.

All barricading and traffic control devices shall be as stated in the current City of Milwaukee D.P.W. "Traffic Control for Construction and Maintenance Work."

3.5.16 Flagperson — Traffic Control

Whenever operations obstruct or endanger a used traffic lane, and no marked detour has been provided, or when the plan so states, the contractor shall furnish a flagperson to direct traffic through or around the congested area. The Commissioner shall have the right to require additional flagpersons as may be deemed necessary. The cost of these flagpersons shall be included in the unit price bid for the work.

3.5.17 Steel Plates for Bridging Trench

The Contractor shall have available a supply of steel plates with minimum dimensions of 4 feet by 8 feet by 1 inch capable of carrying all traffic while spanning the construction excavations. The Commissioner will direct the use of these plates to bridge open trenches crossing a roadway. When used, they shall be secured against possibility of shifting or dropping into the excavation. During winter months, plates shall not be left in the roadway overnight unless specifically approved by the Commissioner. The cost of supplying and installing these plates shall be included in the unit price bid for water main installation.

3.5.18 Removal of Snow

The Contractor shall be responsible for the immediate removal by truck of snow from all areas within and adjacent to the work site which is not removed by normal plowing operations and which would cause an obstruction to traffic.

3.5.19 Dust Palliative

When directed by the Commissioner, the Contractor shall furnish and apply an approved dust palliative on trench surfacing or temporary roadways which the Con-

tractor has provided around the work. This dust palliative shall be applied uniformly and shall be repeated as required. Calcium chloride, sodium chloride, and sulphite materials shall not be used as a dust palliative. The cost of the palliative and its application shall be included in the unit price bid for water main installation.

3.5.20 Protection of Underground Structures

The Contractor shall protect from and be responsible for all damage to existing sewers and sewer appurtenances, utilities and all other structures resulting from his work operations. He shall take all necessary precautions including the driving of tight sheeting to prevent movement of the ground. It shall be the Contractor's responsibility to decide where tight sheeting must be left in place to protect these structures. This is especially pertinent where older structures are encountered. The cost of protecting all structures, including the cost of furnishing and installing sheeting, and bracing and leaving the same in place, shall be included in the price bid for the water main installation unless expressly stated otherwise on the plan(s).

3.5.21 Protection of Trees

The Contractor shall exercise care to assure that tree trunks and limbs are not damaged by his operations. Branches overhanging the trench shall not be trimmed unless specifically allowed in the contract documents or approved by the Bureau of Forestry. Tree trunks shall be encased in wood slats, wired in place, where operations may scar the trunk. Driving of heavy equipment or storage of material within a radius of 8 ft. from the trunk of trees 3 to 8 inches in diameter or within a radius of 10 ft. from trees larger than 8 inches is prohibited unless the area is paved or protected from soil compaction by the use of planks or similar materials.

When working behind the curb, the contractor shall tunnel when the closest trench edge is within an 8 ft. radius of a tree between 3 and 8 inches in diameter. A tunnel is required when the closest trench edge is within a 10 ft. radius of a tree larger than 8 inches in diameter.

At least 3 days before starting construction, the contractor shall call the Bureau of Forestry and arrange to

meet and discuss problems with trees that may be damaged in spite of his exercising care in his operations. Damage to trees resulting from contractor negligence will be repaired by the Bureau of Forestry and the cost billed to the contractor. If excessive damage is done to any tree, the Bureau of Forestry may remove it and replace it at the contractor's expense.

3.5.22 Caulker — Joint Assembler

A City certified "Caulker-Joint Assembler" shall be required to personally assemble all joints on water main and appurtenance installation. Also see section 5.3.8.

3.5.23 Gravel Backfill Credits

Where the material excavated from the trench is suitable for gravel backfill, and gravel backfill is specified in the Contract Documents, the Commissioner may order, in writing, the use of this excavated material in lieu of the gravel backfill specified. The City shall then take a credit for each cubic yard of excavated material used in accordance with Section 2.6.3. The cubic yardage of such backfill will be determined by actual measurements in place.

CHAPTER 3.6.0 PAY ITEMS AND PAYMENTS

3.6.1 The following items are paid for on a lineal foot basis:

ITEM	How Measured	Notes
Water Main 4"-16" (Distribution Mains)	Laid Length — through all fittings	Measurement is from base of bell or end of spigot along centerline of main.
Water Mains 20"-60"	Laid length — through all fittings excluding valves	Measurement is from base of bell or end of spigot along centerline of main.
Blow-off Branch (Tangential)	End of blow-off outlet on main blow-off fitting to C/L of riser tee	End of blow-off outlet may be bell or spigot.
Blow-off Branch (Tee type)	From C/L of water main to C/L of blow-off riser tee	
Blow-off Branch (Riser Pipe)	Entire length of pipe in riser including fitting	From base of bell at bottom of Tee to end of spigot at top.

ITEM	How Measured	Notes
Branch Service (Tapping Sleeve Type)	From base of outside bell of tapping valve to end of branch installation.	Tapping sleeve and valve are not included.
Branch Service (Tee type)	From C/L of water main to end of branch installation.	
Tap Service	From C/L of operating nut of corporation stop to end of service.	Pay measurement not to extend past street line or easement line.
Hydrant Branch	From C/L of water main to C/L of hydrant	
Reducer	One-half of laid length to each size	Each size to be reported separately.
Tunnel	From portal to portal	If not included in price bid for water main.
Bore (No Casing)	From end to end	If not included in price bid for water main.
Jack (Casing)	From end of casing to end of casing	If not included in price bid for water main.
Curb & Gutter	Along face of curb as installed	If not included in price bid for water main.
Saw Cutting	Lineal footage of actual sawing	If not included in price bid for water main.

3.6.2 The following are paid on an area basis:

ITEM	How Measured	Notes
Pavement (as listed below)	When not included in bid price for water main. See Sec. 5.16.18, 5.19.1	
Alley Aproach	Square feet of replacement	This may be designated as driveway.
Driveway	Square feet of replacement	
Base	Square yards of replacement	
Concrete Pavement	Square yards of replacement	Includes streets and alleys
Walks	Square feet of replacement	Usually entire stones
Asphalt Surface	Square yards of replacement	
Sod	Square yards placed as directed	

ITEM	How Measured	Notes
Seeding	Square yards placed as directed	
Bituminous Patch	Square yards placed as directed	
Concrete Shim	Square yards placed as directed	Usually substituted for bituminous patch.

3.6.3 The following are paid as a unit basis:

ITEM	Notes
Abandon Fire Cistern	See 5.14.12
Abandon Manhole	See 5.14.11
Abandon Water Main	See 5.14.6 Only when separate excavation is required to complete abandonment.
Connect Original Service (C.O.S.)	See 5.15.2 May be bid as "long" or "short"
Construct Manhole	Type of manhole will be designated. Milwaukee Water Works will furnish castings and steps.
Cut in Curb Stop (C.C.S.)	See 5.15.3
Cut in Valve	See 5.14.3 Includes any necessary water main removal and installation.
Disconnet Branch (D.B.)	See 5.15.6
Extension of Service (E.S.)	May be bid as "long" or "short". See 5.15.9 May be bid on a lineal foot basis.
Install Hydrant	Hydrant only
Install valve	Feeder main only — valves on distribution mains are included in water main installation.
Remove Hydrant (Major)	See 5.14.8 When excavation for plugging 3-way or capping is required.
Remove Hydrant (Minor)	See 5.14.7 Does not require plugging or capping.
Relocate Curb Stop (R.C.S.)	See 5.15.7.
Remove Valve	Includes any necessary water main removal and installation.
Replace Original Service (R.O.S.)	See 5.15.4 May be bid as "long" or "short". May be bid on a lineal foot basis
Roadway Service Box (R.S.B.)	See 5.15.8

3.6.4 Items to be included in the cost of installing water mains.

The cost of the following work including all necessary materials shall be included in the cost of installing water main unless listed as a bid item or covered by special provisions on the plans.

1. Sawing, breaking, cutting, or removing pavement, curb, driveway or alley.
2. Installing new pavement, sidewalks, curb, driveway, or alley.
3. Installing temporary surfacing, except concrete shim and bituminous material (See Sec. 5.16.18)
4. Installing all polyethylene film envelope.
5. Abandoning water mains, when it is not a separate item.
6. Performing any other incidental work necessary for the completion of the project.

3.6.5 Payment to Contractors

The City will normally make a progress payment (partial payment) on a monthly basis if work completed within the month totals $5,000 or more (See Section 2.5.9 and Section 2.9.12)

The City will base both partial and final payments upon field measurements, quantity determinations and the progress of the work.

Final payment will be authorized after certification of the date of completion of the work.

PART 4

MATERIALS

CHAPTER 4.1.0. WATER MAIN MATERIAL SPECIFICATIONS

4.1.1 Current Specifications

Specifications for certain materials are not included herein but are on file in the Water Engineering Division (W.E.D.) Office as separate documents. Copies are available upon request. These materials are as follows:

Material	WED Specification No.
Corporation Stops	9A
Curb Stops, Ball Valve, ¾" thru 2"	9G
Curb Stops, Inverted Key, ¾" thru 1¼"	9F
Curb Stops, O-Ring Seal, ¾" thru 2"	9E
Fittings, 3" thru 54"	82B
Hydrants	1H
Manhole Frames & Covers	6A
Pipe and Fittings, Concrete, 20" thru 60"	46B
Pipe, Ductile Iron, 3" thru 16"	42B
Pipe, Ductile Iron, 20" thru 54"	45A
Pipe, PVC, 4" thru 12"	49A
Polyethylene Film Envelope	5F
Service Boxes	7B
Service Saddles	9D
Tapping Sleeves	3D
Valve Boxes	7A
Valves, Butterfly, 8" thru 16"	2D
Valves, Butterfly, 20" thru 60"	2M
Valves, Gate, 3" thru 16"	2A

CHAPTER 4.2.0 GENERAL REQUIREMENTS FOR ALL WATER MAIN MATERIAL

4.2.1 Quality of Materials

It is the intent of these specifications to secure new first class materials. Only material conforming to the

requirements of the specifications shall be incorporated in the installation of water mains.

4.2.2 Approval of Water Main Material

All water main material shall be approved by the W.E.D. before installation. Approval will be based on tests, review of certified reports from the manufacturer, measurements and visual examination.

W.E.D. will indicate acceptance of water pipe, fittings, valves, and hydrants by stamping each piece with the W.E.D. symbol. Any of these materials not stamped shall not be installed without the express approval of the Commissioner.

4.2.3 Test Samples

The Commissioner may at his discretion order samples to be taken and tests conducted on any material furnished by the contractor in order to insure compliance with the material specifications.

The size, number, source, and method of obtaining samples and tests performed shall be consistent with the applicable material specification.

4.2.4 Cost of Tests

The cost of obtaining and delivering initial samples to W.E.D. or the City of Milwaukee Testing Lab, shall be borne by the Contractor. The cost of initial tests shall be at the City's expense.

Any additional sampling and retesting which is undertaken in order to obtain acceptance of material that has failed to meet specification requirements shall be at the contractor's expense.

4.2.5 Source of Supply

The source of supply of each of the materials shall be subject to the approval of the Commissioner before use. Approval may be rescinded at any time by the Commissioner, when the sources of supply fails to produce materials that are uniform and satisfactory in quality and of required quantity. If the Contractor desires to furnish material from a source not previously approved for a specific contract, the Contractor shall give sufficient notice so that tests upon which approval will be based can be conducted expeditiously.

4.2.6 Material Storage on Work Site

Materials delivered on the work site are to be safely, neatly and compactly stored along the sides of the roadway in such manner as to cause the least inconvenience to the property owners, the general public and shall not impede traffic. Materials shall not be stored within 20 feet of any hydrant or over catch basins, valve boxes or manholes.

All stone, gravel, or other materials used in the construction work shall be kept in compact piles. All piles shall be provided with proper lighting and barricading.

Piping material may be strung out along the work site if practical. If not, the materials shall be stock piled on the site or stored on trailers.

4.2.7 Handling and Protecting Pipe and Appurtenances

The Contractor shall exercise care in handling all water piping material and appurtenances. Approved equipment shall be available at the site for handling these materials. Chains or steel rope cables shall not be used as slings to lift pipe. Pipe shall be handled so that the cement mortar lining is not damaged. Material shall not be dropped, dragged, or pushed.

When handling valves or hydrants the contractor shall protect the seat and faces against scratches or gouging. He shall also drain all valves and hydrants to protect them from damage by freezing.

Any piping material and appurtenance damaged by the Contractor shall be replaced or repaired, as ordered by the Commissioner, at the Contractor's expense. Material which is not sound or cannot be repaired shall be removed immediately from the job site.

4.2.8 Repair of Damaged Outer Protective Coating

When directed by the Commissioner, the contractor shall repair all damage to the outer protective coating on ferrous materials, with "Kopper's Bitumastic No. 50" or approved equal, with a coating at least as thick as the original coating but not less than 10 mils. Inner coatings shall be repaired by an equivalent coating of Koppers Super Tank Solution or approved equal.

4.2.9 Storage of Yarning, Rubber Gasket Materials, and Polyethylene Film

The Contractor shall store all yarning, rubber gasket material, and polyethylene film in a location that will insure that it remains clean. Rubber gasket material and polyethylene film must also be stored to prevent excessive exposure to high heat or prolonged exposure to sunlight.

4.2.10 Salvage Material

Hydrants dated 1950 or newer shall be returned to the Water Works Stores Division Yard. All water main material removed from the excavation, unless specifically listed on the plan(s) to be returned to the Water Works shall become the property of the Contractor. It shall be removed from the site at no expense to the City.

Unless otherwise noted, all water mains abandoned in place shall not be removed without approval of the Commissioner.

CHAPTER 4.3.0 MATERIAL FURNISHED BY THE CITY

4.3.1 Materials Furnished by the City

The City will furnish the following water main materials unless otherwise noted on the plan(s).

Fittings	Valve Boxes
Valves	Manhole Frames & Covers
Hydrants	Manhole Steps
Corporation Stops	Curb Stops
	Service Boxes

Other miscellaneous items may also be furnished by the City, but only as noted on the specification or contract drawings.

All other materials required to complete the project are to be furnished by the Contractor.

4.3.2 City Delivery

The City will deliver all material furnished by the City and specified in Section 4.3.1 unless otherwise noted on the plan(s). The water main material will be

strung out on the site where convenient in so far as it is possible or practical to do so. If in the opinion of the Commissioner this is not possible or practical, it will be stockpiled on the site or delivered on trailers to the work site. The contractor shall unload or move material so delivered by the City at his own expense.

4.3.3 Responsibility — Damaged or Missing Material

The Contractor's responsibility for material furnished by the City and delivered to the site prior to the actual start of construction shall begin on the day that the Contractor moves on the site. He shall inventory all material delivered prior to his arrival and sign the Water Department's "Stores Material Requisition and Disbursement Report" as a receipt of materials received.

The Contractor's responsibility for materials delivered during construction shall begin upon delivery. He shall sign the "Stores Material Requisition and Disbursement Report" at that time.

The Contractor shall be fully responsible for all material for which he has signed a receipt. If any material is damaged or missing, the Contractor may purchase replacement items from the Milwaukee Water Works or the contractor may replace the damaged or missing material with new material from the contractor's supplier, which must be approved by the City prior to installation.

The Contractor shall examine all material furnished by the City at the time his responsibility begins. He shall reject all material that is defective. Material which is accepted as sound and incorporated into the work, but within the guarantee period of 2 years is found to be defective shall be replaced by the Contractor. If it is found that the defect could have been discovered by the Contractor's visual inspection or if it was caused by his operation, he shall assume the full cost of repair or replacement. If the defect is found to be the City's responsibility, the Contractor will be reimbursed for his costs in accordance with Chapter 2.6.0. The Commissioner will be the sole judge in determining the responsibility.

4.3.4 Return of Materials

Material furnished by the City and not required, and any material removed from the excavation and specifically designated to be returned to the City, shall be de-

livered to the Milwaukee Water Works Stores Division Yard at 3715 W. Lincoln Ave. or other designated location.

Material being returned must be accompanied with a "Surplus Material" form completed by the Public Works Inspector assigned to the project.

CHAPTER 4.4.0 MATERIAL FURNISHED BY THE CONTRACTOR

4.4.1 Material Furnished by the Contractor

Except for materials listed in Chapter 4.3.0, the Contractor shall furnish and deliver any and all materials necessary for the completion of all of the contract requirements.

All material furnished by the Contractor shall comply with or exceed the requirements set forth in the appropriate materials specification referred to in 4.1.0, 4.4.0, and/or subsequent chapters.

4.4.2 Surplus Material

The Contractor shall remove at his expense and without undue delay any surplus material remaining on the work site. The City will not pay for surplus material unless explicitly stated on the plan(s).

4.4.3 Inspection of Water Piping Material

See Section 3.4.13

The Contractor shall have the material easily accessible for inspection by the City and shall furnish any labor and equipment necessary to assist with this inspection at no cost to the City.

The Contractor shall be responsible for all materials furnished by him and shall replace, at his own expense, all materials not complying with the specifications. This responsibility shall include the furnishing of all material and labor required for the replacement of installed material disclosed to be defective within the 2 year guarantee period.

The Contractor shall promptly remove from the site, all defective material furnished by him.

4.4.4. Lead

Lead for jointing purposes shall conform to ASTM Designation B-29.

Lead removed from existing joints on the site may be used. Lead service pipe material or plumber's lead may not be used as jointing material.

4.4.5 Yarning Material

Yarn material shall be of approved dried unoiled jute or unoiled braided hemp or other material accepted by the Commissioner and shall be free from dirt, oil, grease or any substance that would effect the proper installation of the lead joint.

4.4.6 Thrust Restraint Materials, Metal Strapping, Bolts, etc.

Unless otherwise stated in the Contract Documents, the Contractor shall furnish and install all thrust restraint materials to include, but not necessarily limited to concrete anchors, bases, and buttresses, strapping, tie rods, bolts, nuts, turn buckles, bands, washers and mechanical joint follower restraint glands. The cost shall be included in the unit price bid for the installation of the water main.

Thrust restraint strapping, tie rods, bolts, nuts, bands, and washers shall be of high strength, low alloy steel conforming to the requirements of ASTM Designation A-242 or shall be of 300 series 18-8 stainless steel.

The following elements of thrust restraint may be used with mechanical joints and ductile iron pipe:

A) Superstar "Tie bolts", "Tie couplings", and "Tie rod" as manufactured by Star National Products of Columbus, OH.

B) Megalug mechanical joint ductile iron special gland and lugs as manufactured by Ebba Iron Inc. of Eastland, TX.

Only in those instances where specific approval of the Commissioner is granted, mild steel components of a joint restraint system may be used. In that event, the steel bars shall conform to ASTM A-575, any grade from M1012 through M1025, the bolts and nuts shall conform to ASTM A-307, nuts shall be heavy grade, structural shapes shall conform to ASTM A-36 and all elements shall be encapsulated after installation. See

Section 5.3.0, Installation of Water Main and Appurtenances.

The dimensions and installation of the components of the thrust restraint system used shall conform to the respective specification drawings.

4.4.7 Gaskets

Gaskets for flanged joints shall be 1/16″ thick, full faced, and made from plant fiber or other approved material.

4.4.8 Brick and Block

Concrete brick shall conform to the requirements for Grade N-11 as specified in ASTM Designation C-55. Concrete block shall conform to ASTM Designation C-139. All brick and block shall have a depression or keyway in either the top or the bottom.

4.4.9 Precast Manhole Sections

Precast reinforced concrete manhole sections shall meet the requirements of ASTM Designation C-478.

4.4.10 Mortar

Mortar to be used for joints in masonry units, for plastering or for any other specified use shall be in accordance with the requirements of ASTM Designation C270, Mortar Type M.

The mortar shall be mixed in the proportions of the following:

Parts by Volume Portland Cement	Parts by Volume Masonry Cement	Parts by Volume Hydrated Lime	Damp, Loose Mason Sand
1	1	0	Not less than 2¼ and not more than 3 times the sum of the volumes of the cement and lime used.
1	0	¼	

A mixture of any of the above cementitious materials, when furnished in approved packages, may be acceptable in such proportions that when mixed with mason sand and water will produce a suitable mortar and meet the compressive strength requirement of 2500 psi for Mortar Type M of the property specification of ASTM Designation C270.

The Portland Cement, Masonry Cement and Hydrated Lime shall conform to ASTM Designations C150, C91 and C207 Type S respectively.

4.4.11 Timber and Forming Lumber

Timber and lumber used in tunnel, support of trench side walls, and blocking shall be of good quality, reasonably straight-grained and free from weakening knots, warpage, or other defects. The Wisconsin Administrative Code rules of the Department of Industry, Labor, and Human Relations shall govern the sizes and spacings to be used. Timber and lumber used for the bracing and stiffening of forms for concrete structures shall be of good quality, free from weakening knots and of such sizes and spacings and design that will provide a liberal factor of safety and a rigid form for concrete at the rate of pour employed.

4.4.12 Sewer Pipe

All sewer pipe furnished under this classification shall conform to the City of Milwaukee Sewer and Building Service Specifications including all Addenda and/or revisions.

4.4.13 Annular Space Filler — Manhole Walls and Casing Pipe

The annular space between the pipe and the manhole wall as shown in Drawing No.'s 24, 26, 27 and 28 or between the concrete bulkhead in casing pipe and the water pipe as shown in Drawing No. 35 shall be filled with an approved flexible resilient material such as foam rubber, preformed rubber, butyl rubber, or segmented paving felt. The thickness of the filler material on the pipe shall be not less than 2 inches.

4.4.14 Casing Pipe

Casing pipe shall be steel conforming to ASTM Designation A-53 or A-134. Wall thickness shall be as specified in Drawing No. 34.

4.4.15 Polyethylene Film

The Contractor shall furnish and install all polyethylene film and tape. The material shall conform to the appropriate specification listed in Section 4.1.1. The cost shall be included in the unit price bid for the installation of the water main.

4.4.16 Insulation

Rigid Insulation shall be closed cell extruded polystyrene foam, STYROFOAM SM, or STYROFOAM XFS43001 as manufactured by the DOW Chemical Corp. or an approved equal. Minimum width of the insulation board shall be 2 feet, the minimum length shall be 4 feet and the minimum thickness shall be 2 inches. The insulation shall have the following properties:

1) Compressive strength of 40 psi average, when tested in accordance with ASTM D1621.

2) Water absorption of 1% average when tested in accordance with ASTM D2842 or 0.1% when tested in accordance with ASTM C272.

Where specific approval of the Commissioner is granted, perlite or vermiculite concrete encasement or cover may be substituted for the rigid insulation in the ratio of 4" of concrete to 2" of rigid board. The concrete shall have a mix ratio of 1 part Portland cement and 8 parts perlite or vermiculite.

4.4.17 Grass Seed

The grass seed shall conform to the Seed Law of the State of Wisconsin regarding noxious weed seed content. No seed shall be used on the work later than one year after the test date which appears on the label.

Grass seed shall be tested when required in accordance with the methods and procedures used in making purity analysis and germination tests as adopted by the U.S. Department of Agriculture in the Administration of the Federal Seed Act..

The seed mixture shall be composed of seeds of the purity and germination and proportions by weight as follows:

GRASS SEED MIXTURE

	Percent Purity	Percent Germination	Percent Weight
No. 21 Kentucky Blue Grass	85	80	50 to 60
Creeping Red Fescue	97	80	30
Red Top	92	90	0 to 10
Perennial Rye Grass	98	90	10

Each bag of seed shall have a label securely attached showing the ingredients, minimum crop seed, and germination.

4.4.18 Sod

Sod shall be freshly cut, nursery grown grass consisting of 2 or more Kentucky Blue Grass varieties incorporated within the sod, so as to form a polystand. The dominant grass must be of preferred variety. The other grasses should be of the preferred varieties, however, less desirable varieties will be accepted providing they do not occupy more than 40 percent of the stand.

The preferred Kentucky Blue Grass varieties are: Glade, Baron, Victa, Majestic, Adelphi, Bonnie Blue, Parade and Nugget. The less desirable Kentucky Blue Grass varieties are Merion and Flyking.

Sod shall be of uniform thickness with a minimum of ¾ inch. At the time the sod is cut, the grass shall have a length of approximately 2 inches and the sod shall have been raked free of debris.

The sod shall not be cut in a dry condition. In the event of dry weather conditions, the sod shall be watered in sufficient quantities to provide a well-moistened condition of sod to the depth to which it is to be cut. Depending on the nature of the sod, all of the dense root system shall be retained in the sod strip.

CHAPTER 4.5.0 CONCRETE

4.5.1 Concrete Classifications

The classes of concrete to be used for the different

items of construction, unless otherwise specified, shall be in accordance with the following table:

CONCRETE CLASSIFICATIONS

Class of Concrete	Minimum Cement Content, Sacks Per Cu. Yd.	Type of Cement Required	Size of Coarse Aggregate Required	Use
A	7.0	I, IS, IA or ISA	No. 1 plus No. 2 or No. 1 alone	Pavement Pavement Base & Shim, Driveway, Curb & Gutter Special Items or in place of H.E.S. Cement
B	6.5	I, IS, IA, or ISA	No. 1 plus No. 2 or No. 1 alone	Special Construction
C	6.0	I, IS, IA, or ISA	No. 1 plus No. 2 or No. 1 alone	Open Channel, Concrete Pipe, Precast Manholes, Sidewalk, Monolithic Sewers, & Appurtenances
D	5.5	I, IS, IA, or ISA	No. 1 plus No. 2 or No. 1 alone	Envelopes, Cradles, Manhole Bases, Caps, & Riser
E	5.0	I, IS, IA, or ISA	No. 1 plus No. 2 or No. 1 alone	Special Construction
F	4.5	IA or ISA	No. 1 plus No. 2 or No. 1 alone	Anchors, Buttresses, Bases
Backfill Concrete	2¼	I, IS, IA, or ISA	No. 1	Tunnel Backfill, & Backfill Wall
Cellular Concrete	8	I, or IA	None	Tunnel Backfill, Abandoning Sewers, & Grouting Mixture

1. Site-mixed backfill concrete may be proportioned either with one bag of Portland Cement, 6 cubic feet of concrete sand, and 6 cubic feet of No. 1 coarse aggregate or one bag of Portland Cement and 12 cubic feet of graded aggregate.

2. The cement-sand slurry portion of cellular concrete shall be proportioned to contain 8 bags of cement per cubic yard of slurry. Blending the preformed foam with the cement sand slurry shall produce a concrete having a fresh weight of not less than 75 lbs. per cubic foot.

3. Concrete items including sidewalks, driveway, curb and gutter, shall be made with air-entraining concrete containing No. 1 size coarse aggregate only. Pavement shall be constructed with air-entraining concrete containing No. 1 and No. 2 coarse aggregates.

4. For concrete Classes A through E, 75 pounds of flyash from an approved source or water reducing admixture may be substituted for one half sack of Portland Cement per cubic yard of concrete. The addition of flyash or water-reducing admixture shall be formulated to provide the same strength and workability as concrete containing standard materials.

5. High strength concrete mixes (5000 psi and 6000 psi) utilizing both flyash and water-reducing admixture shall be made to a proportion designed by the Commissioner.

4.5.2 Portland Cement

All cement shall be Portland cement unless otherwise specified. The cement shall be an approved brand and shall be the type required for the class of concrete specified for the particular item of construction.

4.5.3 Proportioning

The Commissioner reserves the right to determine the proportioning of all materials of the concrete mix.

4.5.4 Slump

Unless otherwise directed, concrete when discharged from a mixer or ready mix truck shall have a slump of approximately 3 inches as determined by the City in accordance with current A.S.T.M. designation C-143.

4.5.5 Air-Entrained Portland Cement Concrete

Air-entrained Portland cement concrete shall be composed of type IA Portland cement or type I Portland cement plus an air-entraining admixture, fine and coarse aggregates and water.

4.5.6 Quality of Water

City water shall be used wherever available for concrete mixes. If City water is not available, the water proposed for use shall be potable, clear, free from oil, acid, excessive alkalinity, organic matter or other harmful ingredients and then used only with approval of the Commissioner.

4.5.7 Ready Mixed Concrete

Ready-mixed concrete shall comply with ASTM Designation C94 and be prepared at plants approved by the Commissioner. The concrete shall conform to the following requirements.

a. Limitations of Equipment — Mixers and agitators shall be operated within the limits of capacity and speed of rotation designated by manufacturer of the equipment.

b. Truck Mixed Concrete — Concrete that is completely mixed in a truck mixer, shall be subjected to 70 to 100 drum revolutions. The number of revolutions and mixing speed shall be adequate to produce homogeneous concrete.

c. Central Mixed Concrete — For central mixed concrete, the acceptable minimum mixing time for mixers having capacities of one yard or more is one minute for one cubic yard increased by 15 seconds for each additional cubic yard. Where mixer performance tests have been made, the acceptable mixing time may be reduced to a point at which satisfactory mixing has been achieved as defined in ASTM Designation C94, and with the approval of the Commissioner.

d. Addition of Water — No water shall be added after the initial introduction of mixing water to the batch except when on arrival at the job site, the slump of the concrete is less than that specified. When the addition of water is necessary, the drum shall be turned an additional 30 revolutions or more at mixing speed before being discharged.

e. Batch Hopper Scales — Batch hopper scales shall be tested and approved by the local sealer of weights and measures, the Wisconsin Department

of Transportation, Division of Highways or an approved testing service. Approvals shall be obtained at intervals not exceeding 12 months. The hopper scales of portable plants shall be tested and approved after each movement of the plant.

f. Rejected Loads — Rejected loads of concrete shall not be retempered or adjusted by additional ingredients and shall not be shipped to another City contract.

g. Delivery Tickets — A delivery ticket shall be furnished to the inspector with each load of concrete delivered to the project. This ticket shall provide the following information:

1. Name, plant number, and location of ready-mix plant
2. Name of Contractor purchasing the concrete.
3. Project location
4. Date
5. Cement type and brand
6. Admixtures, if used
7. Cement content (sacks per cubic yard)
8. Maximum size of coarse aggregate
9. Truck number
10. Time dispatched
11. Amount of concrete in the load (cubic yard)

h. Maximum Time Before Use — Concrete shall be discharged from a truck mixer or agitator not later than 1½ hours after the introduction of water to cement and aggregate.

i. Certification — The batching plant shall meet the requirements for ready mixed concrete batch plants as set forth by the National Ready-Mix Concrete Association Certification Plan.

4.5.8 Cold Weather Concrete

Concrete delivered in air temperatures between 30 degrees F and 40 degrees F shall arrive at the site of the work having a temperature not less than 60 degrees F. Concrete delivered in air temperatures between 0 degrees F and 30 degrees F shall arrive at the site of work having a temperature not less than 70 degrees F. Heated concrete shall at no time during its production exceed 90 degrees F. The Commissioner may order concreting

discontinued when the air temperature falls below 35 degrees F.

4.5.9 Mechanical Vibration

When ordered by the Commissioner, high frequency mechanical vibrators shall be used in the placement of concrete.

4.5.10 Test Cylinder

When ordered by the Commissioner, test specimens shall be made in accordance with A.S.T.M. current Designation C31. These specimens will be taken by representatives of the Commissioner in 6″ x 12″ cylinders, furnished by the City.

4.5.11 Substituting High Early Strength Concrete (H.E.S.)

If the Contractor at his own request uses high early strength cement or a class "A" concrete to shorten the interval between the pouring of concrete and the placement of load upon the structure, he shall assume the added cost.

When ordered as an extra, the City will pay for the additional cement or high early strength cement used in the concrete in accordance with the prices listed in the Supplemental Schedule of Fixed Prices.

4.5.12 Strength Tests for Monolithic Concrete Construction

All structural concrete construction shall be tested for compressive strength in conformance with A.S.T.M. current Designation C39.

CHAPTER 4.6.0 BEDDING AND BACKFILL MATERIAL

4.6.1 Bedding

a. General — Bedding shall consist of the material produced from crushing hard, tough, durable sound limestone or dolomite ledge rock. Deleterious substances shall not exceed the following:

Deleterious Substances or Particles	Maximum Percentage By Weight
Chert	4%
Coal	0.5%
Clay lumps and friable particles	1.5%
Soft fragments	1%
Any combination of above	4%
Flat, elongated or laminated pieces	10%
Material finer than No. 200 Sieve	1%

b. Bedding Chips — Bedding chips of ⅜″ size shall be used as bedding for 16″ and smaller water mains.

Sieve Sizes	Percentage Passing By Weight
½ inch	100
⅜ inch	90 to 100
No. 8	0 to 15
No. 30	0 to 3

c. Bedding Stone — Bedding stone of ¾″ size shall be used as bedding for 20″ and larger water main.

Sieve Sizes	Percentage Passing By Weight
1 inch	100
¾ inch	90 to 100
⅜ inch	20 to 55
No. 4	0 to 10
No. 8	0 to 5

d. Screenings — Screenings shall be used at the direction of the Commissioner.

Sieve Sizes	Percentage Passing By Weight
½ inch	100
No. 4	75 to 100
No. 100	10 to 25

e. Other Bedding Material — No other bedding material may be used without the approval of the Commissioner.

4.6.2 Gravel Backfill

A. General — Material for backfilling shall consist of

hard, tough, durable particles ranging from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids of the coarse material. No stones over 2 inch sieve size shall be present. Some fine clay or loam particles are desirable, but they shall not be present in the form of lumps.

B. Type "A" — Bank run gravel used as backfill shall meet the following gradation requirements.

Sieve Sizes	Percentage Passing By Weight
2 inches	100
No. 4	35 to 60
Material finer than 200	5 to 15

C. Type "B" — crushed gravel or crushed stone used as backfill shall meet the following gradation requirements.

Sieve Sizes	Percentage Passing By Weight
1 inch	100
¾ inch	85 to 100
⅜ inch	50 to 80
No. 4	35 to 65
No. 40	15 to 30
No. 200	5 to 15

4.6.3 Excavated Material As Backfill

Excavated material used as backfill shall consist of loam, clay, sand, gravel or other materials which, in the judgement of the Commissioner, are suitable for backfilling. Unsuitable backfill materials include vegetable or other organic material, all types of refuse, large pieces or fragments of inorganic material exceeding six inches in any dimension and such other materials as, in the judgement of the Commissioner, are unsuitable for backfilling. Frozen backfill material shall not be used.

4.6.4 Backfill Concrete

See Section 4.5.1 for mixing proportions.

4.6.5 Cellular Concrete

See Section 4.5.1 for mixing proportions.

4.6.6 Aggregate Slurry Backfill

Aggregate slurry backfill shall consist of No. 1 and No. 2 coarse aggregate Class "C" concrete mix with the cement deleted.

The material shall be mixed with water to inundate the aggregate sufficient to provide approximately a 3 inch slump. The mix shall be deposited in the trench directly from a concrete transit mix truck.

CHAPTER 4.7.0 GRADING, PAVING MATERIALS

4.7.1 Crushed Stone

a. General Requirements — Crushed stone shall consist of material produced from crushing hard, tough, durable sound limestone or dolomite ledge rock. Deleterious substances shall not exceed the limits listed in Section 4.6.1a.

Stone which fractures to flat and elongated pieces is not aceptable.

b. Gradation Requirements — Crushed stone, and crushed stone screenings shall comply with the gradation requirements specified in the following table:

(a) 2½ inch Crushed Stone (ASTM C33-Size No. 2)

Sieve Sizes	Percentage Passing By Weight
3 inch	100
2½ inch	90 to 100
2 inch	35 to 70
1½ inch	0 to 15
¾ inch	0 to 5

(b) 2 inch Crushed Stone (ASTM C33-Size No. 3)

Sieve Sizes	Percentage Passing By Weight
2½ inch	100
2 inch	90 to 100
1½ inch	35 to 70
1 inch	0 to 15
½ inch	0 to 5

(c) 1½ Inch Graded Crushed Stone

Sieve Sizes	Percentage Passing By Weight
2 inch	100
1½ inch	85 to 100
1 inch	65 to 90
¾ inch	50 to 80
No. 4	30 to 60
No. 10	20 to 50
No. 40	10 to 30
No. 200	5 to 15

(d) Crushed Stone Screenings

Sieve Sizes	Percentage Passing By Weight
½ inch	100
No. 4	75 to 100
No. 100	10 to 25

4.7.2 Graded Aggregate

Graded aggregate shall consist of gravel, crushed gravel or crushed stone and be composed of hard, sound, durable particles and a filler of sand, stone dust or other finely divided mineral material. It shall comply with ASTM Designation D1241, Specification for Soil — Aggregate Sub Base and Surface Courses, except as modified as follows:

a. It shall be free of clay lumps and vegetable matter.

b. The fraction passing the No. 200 sieve shall be less than ½ the fraction passing the No. 40 sieve for gravel aggregate, and less than 0.7 for crushed stone aggregate.

c. If filler, in addition to that naturally present in graded aggregate is necessary to meet the grada-

tion requirements or for satisfactory binding, it shall be uniformly blended with the aggregate at the screening plant.

d. At least 50 percent of the particles held on the No. 4 sieve shall have at least one fractured surface.

e. It shall meet the grading requirements for the pertinent type as specified in the following table:

Percentage Passing by Weight

Sieve Size	Crushed Road Gravel	¾ inch Graded Crushed Stone	1½ Inch Graded Crushed Stone
1½ inch	——	——	100
1 inch	100	100	——
¾ inch	85-100	85-100	——
⅜ inch	50-80	50-80	30-65
No. 4	35-60	35-65	25-55
No. 10	25-50	——	15-40
No. 40	15-30	15-30	——
No. 200	5-15	5-15	2-12

4.7.3 Screenings

See Crushed Stone Screenings in Section 4.7.1(d).

4.7.4 Bituminous Patch Material

Bituminous patch material shall meet the following requirements:

(A) Grade of Liquid Asphalt — The grade of liquid asphalt mixed, stored, used or applied during the period of October 1st through April 30th, shall be grade MC250 meeting AASHTO Designation M82. During the period May 1st thru September 30th, the liquid asphalt mixed, stored, used, or applied shall contain a maximum 5 percent by weight of petroleum solvent.

(B) Percent of liquid asphalt — The percent of liquid asphalt shall be in the range of 4 to 6% by weight of the total mix.

(C) Gradation — Aggregate gradation requirements

for bituminous mixes shall be as listed in the following table:

Sieve Size	Percentage Passing By Weight
½ inch	100
⅜ inch	90 to 100
No. 4	60 to 80
No. 8	35 to 65
No. 16	
No. 30	
No. 50	6 to 25
No. 100	
No. 200	2 to 10

4.7.5 Asphaltic Pavement Mixes

Asphaltic pavement mixes shall conform to the requirements of the Street Construction Specifications.

4.7.6 Concrete Pavement

Concrete pavement shall conform to the requirements of the Street Construction Specifications.

PART 5

CONSTRUCTION

CHAPTER 5.1.0 EXCAVATION

5.1.1 Code Requirements

All work shall be performed in accordance with the Wisconsin Administrative Code on "Trench, Excavation, and Tunnel Construction" and any additional requirements included in the Contract Documents.

5.1.2 Excavation Required

Water Mains shall be installed in open cut trench section unless otherwise indicated on the plans. Exceptions from this procedure may be permitted to allow for tunneling, boring, or jacking with the express approval of the Commissioner.

The Contractor shall do all excavation work required for the completion of all work required by the contract including excavation work required for hydrostatic testing, and chlorination. He shall also excavate to obtain water samples from mains and appurtenances and to install closures and provide temporary water service.

Unless otherwise indicated in the contract documents, the unit price bid shall include the cost of all such excavation and minor tunneling or boring.

5.1.3 Length of Open Trench

The Contractor shall have no more than 400 feet of trench open at any one time. In no case shall he close more than one street crossing with the same trench or operation at any one time, except by written permission of the Commissioner.

When nighttime temperatures are forecast to fall below freezing, the Contractor shall not leave more than 100 feet of trench open overnight. Also see Section 5.16.7.

5.1.4 Dimensions of Trench

(A) Depth — In earth the Contractor shall excavate a

minimum of three inches and a maximum of six inches below the outside of the barrel of the pipe. In rock excavation the minimum shall be six inches and the maximum nine inches below the outside of the pipe barrel. These depths shall be checked for the entire length of every pipe prior to the placing of any bedding material. If depth of the excavation is greater than these defined limits, the Contractor at his own expense, shall backfill and compact to the proper depth with material approved by the Commissioner before placing bedding material.

Bell and coupling holes shall be excavated to provide three (3) to six (6) inches of bedding under the installed bell or coupling but no larger than necessary for joint assembly. In rock excavation, a minimum of four (4) inches of bedding shall be provided. For a lead joint, sufficient space shall be provided for pouring and caulking the joint. Excessive excavation shall be backfilled and compacted with material and in a manner prescribed by the Commissioner at no extra cost to the City.

(B) Width — The trench shall be wide enough to provide a six inch minimum clearance between the outside of the pipe barrel and the face of any trench sheathing or bracing. In trenches without sheathing or bracing, this clearance shall be to the side wall of the trench. For pipe other than ductile iron and for ductile iron pipe 20″ diameter and larger, the maximum trench width at the top of the pipe shall be the outside diameter of the pipe plus 2 feet. The remaining trench walls shall be kept vertical whenever possible.

Sidesloping or "benching down" of the trench will be permitted except where such sidesloping or benching would encroach upon private property or endanger existing or future underground utilities or structures or pavement. Where sidesloping or "benching down" is used, the maximum trench width at the top of the pipe shall not be exceeded.

The Commissioner may prohibit sidesloping or benching if in his judgement this method of construction is detrimental to the City.

When sidesloping is done, it shall not be carried deeper than 2 feet above the top of the pipe.

If the above maximum trench widths are exceeded, the Commissioner may order special bedding at no additional cost to the City.

5.1.5 Bottom of Excavation

The Contractor shall remove all lumps, loose pieces of material, and stones exposed in the bottom of the excavation. Any holes created in the bottom of the excavation by the removal of stones or other objects shall be filled and compacted with crushed stone, or other material approved by the Commissioner at no extra cost to the City. The Contractor shall remove any soft and/or other unstable material before he places the bedding. When the trench bottom is unstable, or contains other unsuitable materials, the work shall conform to Section 5.3.3.

5.1.6 Excavation in Rock

When rock is encountered, the surface shall be stripped of earth and shale and the Commissioner notified in order that the trench may be measured and cross-sectioned before rock is removed. In lieu of stripping the earth overburden prior to blasting, the Commissioner and the Contractor may mutually agree on a method to define the vertical limits of the rock. Any rock excavated, before such measurement or agreement is made will not be paid for. Rock excavation shall be defined as hard, solid rock in ledges, bedded deposits and unstratified masses, and all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock. This shall include all masonry or concrete structures not shown on the plans. Shales, hard pan, masonry and concrete rubble, boulders less than one cubic yard which are not a part of or attached to substrata of rock, shall not be considered rock excavation. Where there is no bid price for rock excavation the City will pay for such rock excavation at the unit price named in the Schedule of Fixed Prices.

The trench in rock excavation shall be excavated to a minimum of 6 inches below the outside of the barrel and 4 inches below the bell of the pipe. The pay depth for rock excavation in open cut shall be the minimum permissable depth of excavation below the pipe.

The pay width for rock excavation in open cut shall

be the actual width of excavated trench but shall not exceed the outside diameter of the pipe plus 24 inches.

The pay quantities for rock excavation in tunnel shall be the actual volume of rock excavated within the following limit:

Standard Tunnel Section — Ten inches beyond the outside of the barrel of the pipe to be installed, but not less than 4 feet vertical and 3 feet horizontal (Wisconsin Administrative Code Regulation).

5.1.7 Excavated Materials

The excavated material to be used for trench backfilling must be stored so that it will cause a minimum of inconvenience to public travel, adjacent property owners, tenants or other Contractors.

The excavated material which is not to be used for trench backfilling shall be removed immediately from the site.

No claim for extra payment will be allowed because of the presence of quicksand or other materials tending to increase the excavating costs, unless specifically provided for in the Contract Documents.

5.1.8 Excess Excavated Material

(A) The Contractor shall not dispose of any excess excavated material in any waters of the State or on wetlands without written approval from the Wisconsin Department of Natural Resources.

(B) Excess excavated material shall be disposed of by the Contractor at the Contractor's own option and cost unless the Contractor is otherwise directed by the Contract Documents, with the exception as specified in Section 5.1.8 (C).

(C) The Commissioner may order a quantity of up to 10 percent of the excess excavated material to be delivered to streets, alleys, public properties, or other locations designated by the Commissioner. The cost of delivering such excess material to any point within a radial distance of one mile from the site of the work shall be included in the price bid for water main installation. After delivery to

the designated locations, the material shall be properly leveled off by the Contractor.

5.1.9 Drainage of Excavation

The Contractor shall keep all excavations free of water or sewage and debris during the entire construction period.

No ground or surface water shall be allowed to drain into any existing sanitary sewer. No work shall be performed under sewage or under water except with the approval of the Commissioner, and then only in accordance with methods prescribed by the Commissioner. The cost of constructing flumes, dams, sumps or pump wells, and the cost of pumping or bailing shall be included in the price bid for the work.

5.1.10 Dewatering Sumps and Pump Wells

Dewatering sumps and pump wells are to be properly sheathed and braced while in use, and when abandoned, shall be backfilled in the manner described for all backfilling. The cost for making all extra excavations necessary to prevent the water from interfering with proper construction practices, and for forming all dams, and furnishing and laying of underdrains, digging of sumps or wells, bailing and fluming, shall be borne by the Contractor, and included in the bid prices for items of work.

If wells are being used for dewatering purposes, the wells shall be drilled, maintained and abandoned in accordance with the requirements of the Wisconsin Department of Natural Resources.

5.1.11 Underground Interference

Where an existing underground structure is encountered in the trench or the tunnel of the proposed water main, and because of interference, such underground structure requires relocation or partial removal, the Contractor shall immediately give notice of such interference to the Commissioner and the owner of the underground structure.

The Contractor, upon the written order of the Commissioner, shall make any necessary excavation for such relocation and will be paid the basis of payment for al-

tered work as specified in Chapter 2.6.0.

The relocation of structures owned by other utilities will usually be made by the owner. However in the event that the Contractor is ordered by the Commissioner, in writing, to make such relocation, the Contractor will be paid for altered work as specified in Chapter 2.6.0.

No extra compensation will be paid for delays caused by the interference of existing underground structures.

In the event that the relocation of a structure is to be made for the convenience of the Contractor rather than because of actual interference with the proposed water main or structure, the Contractor shall first notify the Commissioner and the owner of the underground structure of the Contractor's desire to temporarily relocate such structure or to discontinue the service thereof, and receive permission from the owner for such relocation or discontinuance of service. Replacement to original position and condition if required, shall be made at no cost to the owner or the City.

The City will do all work on its structures in connection with relocation, discontinuance and replacement, billing the Contractor for all costs of same or with the approval of the City, the relocation, discontinuance and replacement may be made by or arranged for by the Contractor at the Contractor's own expense.

Where the excavation of either trench or tunnel extends under or approaches an underground structure in a manner to endanger it, the Contractor shall be responsible for the protection of such structure and shall brace, support and otherwise protect it.

5.1.12 Ladders

The Contractor shall supply a substantial ladder for access to all trenches more than six feet in depth. The ladder shall project out of the trench at least 36 inches. It shall be available for the Inspector's use at any location on the job site where his work requires that he descend into the trench.

5.1.13 Clearing and Grubbing of Trees

No trees shall be removed, cut down, or trimmed except as permitted in Section 3.4.21. Only those trees or

stumps 4 inches in diameter and over shall be considered pay items for clearing and grubbing. The following methods shall be used in the disposal of trees and stumps.

(A) Tree Clearing — The leaves, limbs, or logwood from all trees, shall be disposed of by the Contractor at his expense, within 5 days after being topped, cut down or removed. Clearing shall consist of cutting and disposing of the portion of the tree above the swell.

(B) Tree Grubbing — Root stumps from trees shall be disposed of by the Contractor at the Contractor's own expense. Root stump removal by chipping type equipment is permissable. Grubbing shall consist of the removal and disposal of the root stump.

5.1.14 Thawing of Frozen Ground

The Contractor shall obtain a permit from the Department of Building Inspection and Safety Engineering before building a fire to thaw frozen ground and shall comply with all conditions of the permit. Thawing shall be accomplished by burning an approved fuel which does not emit excessive smoke or flame or otherwise inconvenience the public. No wood fuel shall be used to thaw ground unless specifically permitted by the Commissioner. The Commissioner may prohibit burning whenever it is deemed undesirable.

5.1.15 Tree Tunneling

Timber tunnel sets shall be used under trees for the entire length of tunnel as required by Paragraph 3.4.21. Boring may be used in place of tunneling. The cost of tree tunneling or boring shall be included in the bid price for installing the water main.

5.1.16 Exposing Existing Water Mains

When the water main installation approaches a point of connection or closure, the Contractor shall expose the main sufficiently in advance of the water main installation to provide for the connection to the new main without special fittings. Any additional costs incurred due to a deviation from this procedure shall be borne by the Contractor.

The Contractor shall protect and block the exposed end of an existing main under pressure to prevent blowing out of the plug or cap. On water mains 16 inches in diameter or larger under pressure, the Contractor shall not excavate below the top of the buttress for a minimum distance of ten feet from the back of the concrete buttress. The Contractor shall increase this distance if water or unstable ground conditions are encountered.

CHAPTER 5.2.0 SHEATHING, BRACING AND SHORING

5.2.1 Excavation to be Sheathed, Braced and Shored

Open-cut trenches shall be sheathed and braced as required by the Wisconsin Administrative Code, the Contract Documents, and as may be necessary to protect life, property or the water main installation. When close sheathing is required, it shall be driven so as to prevent soil from entering the trench either below or through the sheathing.

The shoring and bracing of tunnel excavations shall conform to the requirements of the Wisconsin Administrative Code and to any additional requirements of the Contract Documents. Tunnel timber sets shall be placed so as to prevent the infiltration of solid material into the tunnel excavation as specified in the chapter on Tunnels in the Sewer and Building Services Specification.

The Commissioner may allow close sheathing to be set in place rather than be driven, providing that ground conditions are suitable and that the trench is properly braced prior to the placing of sheathing. Any voids behind the sheathing shall be immediately filled with gravel backfill material.

5.2.2 Lower Limits of Sheathing

The Commissioner reserves the right to order the sheathing driven to the full depth of the trench or to such additional depths as may be required for the protection of the work. Where the soil in the lower limits of a trench has the necessary stability, the Commissioner, at his discretion, may permit the Contractor to stop the

driving of sheathing at some designated elevation above the trench bottom. The granting of permission by the Commissioner, however, shall not relieve the Contractor in any degree from full responsibility for safety or proper execution of the work.

Where the sheathing is driven below the top of a concrete cradle or envelope, the Contractor shall use building paper or other suitable material to break the bond between the concrete and the sheathing to permit the removal of the sheathing. Where the sheathing is driven below the top of a concrete buttress the Contractor shall cut off the sheathing above the buttress to permit its removal and leave the remaining sheathing in place.

5.2.3 Removal of Sheathing and Bracing

Trench sheathing and bracing, including sections which have been ordered left in place, shall be removed for a distance of 3 feet below the established street grade or the existing surface grade, whichever is lower.

Trench sheathing and bracing may be removed before the trenches are flooded, but only when and in such manner as will insure adequate protection of the completed water main and adjacent underground or surface structures, and prevent the disturbance of adjacent ground. Trench bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing. Sheathing, except that which must be left in place, may be removed after the backfilling has been completed or has been brought up to such elevation as to permit its safe removal.

5.2.4 Cost of Sheathing and Bracing

The cost of furnishing, placing, and removing sheathing and bracing in open-cut trench, and the leaving in place of sheathing and bracing as indicated on the plans shall be included in the price bid for the work. When sheathing and bracing has been ordered in writing as an extra by the Commissioner or when sheathing and bracing has been ordered left in place as an extra, by written order of the Commissioner, the payment shall be made in accordance with the terms of Chapter 2.6.0. When sheathing and bracing has been ordered left in place as an extra, by written order of the Commissioner, pay-

ment shall include the upper 3 feet of the sheathing which is removed. The sheathing and bracing shall include all stringers and cross braces deemed necessary by the Commissioner to protect the work. The cost of furnishing and placing shoring and bracing in tunnel construction shall be included in the price bid for water main in tunnel.

5.2.5 Failure to Order Sheathing and Bracing Left in Place

The right of the Commissioner to order sheathing and bracing left in place shall not be construed as creating any obligation on the Commissioner's part to issue such orders. The failure to exercise the Commissioner's right to do so shall not relieve the Contractor of any liability for damages to persons or property occuring from or upon the work, growing out of a failure on the part of the Contractor to leave sufficient sheathing and bracing in place in the trench to prevent the caving or movement of the ground or disturbance of the completed work or any of the surface or subsurface structures.

5.2.6 Portable Trench Box or Sliding Trench Shield

Portable trench boxes or sliding trench shields approved by the Wisconsin Department of Industry, Labor and Human Relations may be used as long as in the judgement of the Commissioner, job conditions warrant such use. Use of the shield shall not relieve the Contractor of any liability for damages to persons or property occuring from or upon the work of constructing the water main and appurtenances, growing out of a failure on the part of the Contractor to leave in place in the trench sufficient sheathing and bracing to prevent the caving or movement of the ground or disturbance of the completed work or any of the subsurface or surface structures, including pavement. The replacement of any facilities not included in the contract shall be paid for by the Contractor.

Care shall be taken when a trench box or shield is moved ahead so as not to pull apart the pipe previously joined or leave voids around the pipe.

When required by the Commissioner, the Contractor shall provide an acceptable method of rechecking line, grade and horizontal location of the pipe after the shield

has been moved ahead. If the pipe has moved, it shall be reinstalled to the proper line and grade.

The trench box or shield shall not be used when it would extend to behind locations of buttresses, thrust collars, or anchors which requires concrete to be poured against the undisturbed trench wall.

The width of the trench shield or box shall be such that a minimum 6 inch horizontal clearance is maintained between the pipe and shield at all times.

Any voids occuring between the trench box or shield and the undisturbed trench wall within the pipe zone (bottom of trench to top of bedding material) shall be filled with bedding material, immediately after the box or shield is positioned.

CHAPTER 5.3.0 INSTALLATION OF WATER MAINS AND APPURTENANCES

5.3.1 Water Main Material Substitutions

When furnishing water main materials, the City reserves the right to make nominal substitutions of fittings, including type of joint, at no additional cost to the City.

5.3.2 Line and Grade for Open-cut Construction

(A) Grade Boards

The Contractor shall furnish and install the line and grade boards. A substantial vertical support shall be provided one each side of the trench on a line perpendicular to each stake of the primary line. A substantial straight and even-edged 2″ by 6″ board shall be attached to these vertical supports in a horizontal position and at some even foot height above the grade line of the proposed water main. The plans show the grade line of proposed water mains, 4″ through 16″ diameter as the centerline, and proposed feeder mains, 20″ or larger diameter as the flow line of the main unless otherwise noted.

The center line of the proposed water main shall be located by measurements from the primary line stake and marked upon the board.

Not less than 3 line and grade boards shall be set initially and immediately checked visually for error. As each additional board is placed it shall be checked visually with the last two sets. At least 3 consecutive boards shall be maintained at all times. During the installation of the pipe, a high strength twill line shall be fastened to the board at the center alignment marks and pulled sufficiently tight to remove any noticeable or measurable sag. The boards and their vertical supports must be set firmly enough to withstand such pull without distorting. If the visual inspection of the grade board discloses an apparent error, each board shall be checked and if the apparent error still exists, the Commissioner shall immediately be notified, in order that the primary grade stakes may be checked.

The alignment of each pipe shall be obtained by plumbing down from the line. The elevation of the pipe shall be established by measuring down from the line by means of an approved grade pole.

(B) Laser Beam

1. The Contractor may use the laser beam method of maintaining line and grade after demonstrating that a qualified operator will handle the equipment during the course of construction. A placard titled "Caution-Laser Light" shall be mounted in a conspicuous place.

2. When the "in the pipe" laser beam method is used, grade boards will be required to install the first 50 feet of pipe. The Contractor shall check the line and grade at any additional points at which offset stakes have been placed and at other locations requested by the City.

3. If air temperature variations cause the "in pipe" laser beam to bend, a fan shall be provided to circulate the air. However, air velocity shall not be so great as to cause pulsating or vibrating of the beam. If, in the opinion of the

Commissioner, the beam cannot be accurately controlled, this method of establishing line and grade shall be abandoned.

4. When the "above ground" method is used, the set up shall be checked with 3 grade boards including one set a minimum of 5 primary grade stakes beyond the excavating equipment or at the next grade change or P.I. This advance board shall be retained as a check as pipe laying progresses. If the laser has a gradient indicator and the gradient of the proposed water main is known or calculated, 2 boards shall be used to check the set up.

5. The beam alignment shall be verified at least once during the first half of work shift and at least once more during the second half of the work shift. More frequent checks of the beam may be ordered by the Commissioner when warranted by job conditions.

(C) Banjo String

1. With the approval of the Commissioner, "banjo strings" may be used when the width of the trench excavation exceeds 14 feet. The strings shall be set a minimum of 6 feet apart on 2 inch by 6 inch grade boards supported by 2 standards.

   When the horizontal distance from the centerline of the pipe to the closer string exceeds 24 feet the distance between strings shall be increased by ¼ of the increased distance.

5.3.3 Bedding

Bedding for water mains shall consist of Bedding Chips or Bedding Stone as specified in Section 4.6.1 unless otherwise noted on the plan(s) or directed by the Commissioner. The Contractor shall place the bedding material by hand or by equally careful means. Bedding for all mains and branches shall extend three (3) to six (6) inches below the pipe in an earth excavation and six (6) inches to nine (9) inches below the pipe in a rock excavation and six (6) inches above the pipe and to the trench walls completely enveloping it. The bedding

shall provide a uniform bearing and support at the required line and grade.

Bell and coupling holes shall be excavated in accordance with Section 5.1.4 (A).

Where the bottom of the trench contains marsh muck, acid soil, ash, refuse or cinder filling, all such materials shall be removed by the Contractor and the main shall be bedded in limestone screenings instead of normal bedding materials.

If the bottom of the trench is unstable or otherwise unsuitable, the Commissioner, will order the removal of the unstable or unsuitable material to a prescribed depth and require replacement to normal sub-grade depth with approved material. This work will be paid for in accordance with the schedule of fixed prices.

The Contractor shall take care when placing the bedding material after the pipe is in place to be sure that it flows completely around and under the pipe to provide uniform support. The Contractor shall use mechanical vibrators to eliminate voids on feeder main installation.

Bedding material frozen into clumps shall not be used.

5.3.4 Wood Blocking

Wood blocking may only be used to support valves, valve boxes, hydrants, fittings, and special castings.

5.3.5 Direction of Installation

Pipe shall be installed with the bell ends facing the direction of installation unless otherwise directed or approved by the Commissioner. Bells shall face upgrade for lead jointed mains installed on a grade over five percent except for fittings and special castings which shall be installed according to the plan. Bells on rubber gasket jointed mains shall face upgrade on any grade over 30 percent.

On feeder main installations the Contractor shall submit a laying schedule to the Commissioner for approval. This laying schedule, listing sequence and direction of installation, shall be followed, field conditions permitting.

The Commissioner must approve any major deviation from this laying schedule prior to installation.

5.3.6 Pipe Inspection and Repair of Pipe Materials

No material shall be incorporated in the water main installation unless it has been inspected and approved by the City.

Before being installed, piping material shall be visually inspected for defects or cracks. The City will remove and replace all defective material furnished by the City. All defective material furnished by the Contractor shall immediately be removed from the site.

The City will check all concrete water pipe delivered to the project site prior to installation, for cracks, irregularities in spigot and bell ends that may have occured after the pipe was inspected at the manufacturer's plant. All defective material shall be satisfactorily repaired or replaced.

The Commissioner shall approve the method and the repair of minor damage to concrete pipe before the pipe can be incorporated into the line. Pipe on which a joint ring has been bent or otherwise damaged to the point that the steel ring is separated from the adjacent concrete shall not be used or repaired.

The Contractor shall file smooth any roughness or sharp points that may cut the gasket, before each concrete pipe joint is assembled.

Field repairs to any other type of water main materials will not be accepted without the express approval of the Commissioner.

5.3.7 Pipe Jointing

Joints shall be made in compliance with Chapter 5.4.0 for lead joints, 5.5.0 for push on joints, 5.6.0 for mechanical joints, 5.7.0 for prestressed concrete joints and 5.8.0 for polyvinyl chloride pipe. The Contractor shall secure the pipe with bedding material carefully placed along its sides and over the top as required in Section 5.3.3. before assembling joints.

All joints in water mains shall be installed by certified caulkers or joint assemblers.

5.3.8 Caulker — Joint Assembler

A City certified "Caulker-Joint Assembler" shall be required to personally assemble all joints on water main and appurtenance installation.

A "Caulker-Joint Assembler" is certified and issued a "Caulker-Joint Assembler" card after passing a qualification test conducted by the City. This card should be carried on the job at all times. No water main installation shall commence without a certified "Caulker-Joint Assembler" present to assemble each joint.

"Caulker-Joint Assembler" tests can be scheduled through the Construction Division of the City Engineer's Office. A fee is charged for administration of the certification test.

5.3.9 Closures

When the water main installation approaches a point of connection or closure, the Contractor shall expose the main sufficiently in advance of the water main installation to provide for the connection to the new main without special fittings. Any additional costs incurred due to a deviation from this procedure shall be borne by the Contractor.

The Contractor shall protect and block the exposed end of an existing main under pressure to prevent blowing out of the plug or cap. On water mains 16 inches in diameter or larger under pressure, the Contractor shall not excavate below the top of the buttress for a minimum distance of ten feet from the back of the concrete buttress. The Contractor shall increase this distance if water or unstable ground conditions are encountered.

5.3.10 Permissible Deflections of Pipe

Deflections of the pipe shall not exceed that tabulated in Drawing No. 1. Deflections for piping material not listed in Drawing No. 1 shall be limited to those recommended by the pipe manufacturer and approved by the Commissioner.

5.3.11 Cleaning Interior of Pipe

All pipe shall be clean and free from foreign material prior to being installed. The Contractor shall do all

cleaning required by scraping, brushing, washing or air blasting.

5.3.12 Sanitary Protection of Pipe Interior

The Contractor shall have the necessary sizes of approved test or sanitary plugs or caps on the site at all times. These plugs and caps shall be set in the bell or on the spigot end of the pipe immediately after it is installed and not removed until the work is ready to proceed to prevent the entry of rodents or debris.

On feeder main installations, a well constructed snug fitting wood or steel fabricated plug will be acceptable. These plugs shall be set in the bell whenever actual pipe installation is not in progress.

5.3.13 Contamination

When mains are installed under conditions where, in the opinion of the Commissioner there is possibility of contamination, the City will furnish and the Contractor shall insert a quantity of a powdered chloride compound. The Commissioner will specify the amount of this chemical to be used and the locations and method of application.

In the event of serious contamination, the Commissioner may order the chlorination of the water main.

If in the opinion of the Commissioner contamination has occured because of poor construction practices or carelessness by the Contractor, the Commissioner shall order cleaning and chlorination of the main at the Contractor's expense.

5.3.14 Clearance of Underground Obstructions

Water mains shall be installed to provide a minimum clearance of six inches from all underground utility structures and other obstructions unless otherwise directed by the Commissioner.

5.3.15 Offset to Clear Obstructions

When it becomes necessary to install a water main over, under or around an obstruction, the offset will, if possible be accomplished by breaking joints within the limit set forth in the section on joint deflection. If this is

not possible or practical, the Contractor shall install the necessary bends, offsets or bevel pipe to clear the obstruction. When offsets are made under sewers, culverts or other obstructions, the number of joints under such obstruction shall be an absolute minimum. Unless otherwise directed by the Commissioner, the main shall be returned to the plan line and grade immediately upon clearing the obstruction.

The offset footage shall be measured and paid for at the unit bid price measured along the laying length of the offset. Payment for any additional fittings required to be furnished by the Contractor and costs for additional excavation and pipe restraint shall be made in accordance with the provisions of Chapter 2.6.0

5.3.16 Cutting of Pipe Material

All ductile or "grey" cast iron pipe shall be cut with a circular power saw or other approved mechanical pipe cutter. Cutting of any other type of pipe material shall be by methods recommended by the pipe manufacturer. Except for the furnished "closure" pieces concrete pressure water pipe cannot be cut.

All cuts shall be perpendicular to the center line of the pipe. The maximum acceptable misalignment for all completed cuts shall be ½" for distribution mains and 1" for feeder mains.

5.3.17 Installing Valves and Valve Boxes

Valves shall be in a closed position at the time of installation. The Contractor shall carefully clean the valve seats before installation.

The Contractor shall install valves and valve boxes where indicated on the plan(s), and in accordance with Drawings No. 21, 22 and 23. The boxes shall be centered over the valve operating nut. The entire box assembly shall be secured in place for placing backfill.

The Distribution Division will install an extension rod on the operating nut of valves set deeper than 8 feet. The Contractor shall provide 3 days notice prior to the time that an extension rod is required. Valve box extensions shall be used when valve boxes have to be extended to a height greater than the maximum of a

standard box height and up to 10 feet in height. On valve boxes greater than 10 feet in height, the added length shall be obtained by using valve box mid-sections leaded together, or 6″ diameter "gray" or ductile iron pipe used as a mid-section as approved by the City.

The Contractor shall reset valve boxes that have shifted during backfilling. The top of the box is to be set at the existing grade unless otherwise noted on the plan, or required by the Commissioner.

Butterfly valves shall be installed with the operator on the side indicated on the plan(s) by a dot. The location is further defined in the notation for material by the symbol OP. followed by N, S, E, or W, the direction of the operator with respect to the center of the pipe as required. Usually this will be toward the high side of the pavement.

5.3.18 Installing Hydrants

Hydrant units shall be installed where and as indicated on the plans and in accordance with Drawings No. 18, 19 and 20. Where hydrants are set in hollow walk areas, the property owner must construct a masonry wall enclosure as shown on Drawing No. 20.

Hydrants are furnished in various lengths. The Contractor shall be responsible for installing the proper length as shown on the plan.

Hydrants shall be set vertically within a maximum tolerance of ⅛″ per foot.

If the bury point of a hydrant, when set according to plan grade, will temporarily be below existing ground elevation, the Contractor shall dish out around the hydrant at a 2 horizontal to 1 vertical slope from 6″ below the center of the break-away joint up to the existing ground elevation. If the hydrant extends above grade to the extent that more than 1 foot of the barrel below the break-away joint is exposed, the Contractor shall place and compact excavated material at a 2 horizontal to 1 vertical slope to 6 inches below the center of the break-away joint.

If either of the above result in blockage or ponding of surface drainage, the Commissioner may order, as an extra, the installation of culvert pipe or other drainage

means to correct the condition.

5.3.19 Thrust Restraint

Thrust restraint is required behind all tees and hydrants, at caps, at plugs, and at all changes in direction of water mains greater than 12°. For water mains 30″ and larger, thrust restraint is required at all changes of direction greater than 5½°, unless otherwise noted on the plans. The Contractor shall furnish and install all material necessary for restraint of water mains and appurtenances as shown on the contract drawings. Requirements of joint restraint will normally not be shown or called for on the contract plan but unless specifically deleted shall be required.

If more than one type of thrust restraint is shown on the specification drawings, the Contractor has the option of determining which system of restraint to use, unless ordered to use a particular type by the Commissioner.

Strapping and bolting materials shall be installed prior to wrapping of the water main with the polyethylene envelope. Where this is not feasible, such as with turnbuckles, U-bolts and some rodding, these elements shall be given a complete coating of Kopper's No. 50 or 505 not less than 30 mils thick or plastic roofing cement not less than 50 mils thick after installation.

When the use of mild steel strapping materials has been expressly permitted by the Commissioner, all elements of such strapping and bolting material, whether or not within the polyethylene envelope, shall be given a complete coating of Kopper's No. 50 or plastic roofing cement not less than 50 mils thick after installation.

All concrete buttresses shall be formed to the dimensions shown and shall be poured against undisturbed ground in the direction of the thrust. In the event that the ground in this direction is unsuitable for loading or has been removed, the buttress shall be enlarged or otherwise altered to provide the proper area for soil reaction.

When the pipe is reduced in size the larger diameter shall determine the dimensions of the restraint to be installed.

All costs of restraint shall be included in the unit price bid for the water main or appurtenance installed, unless ordered as an extra by the Commissioner.

Valves on all branches shall be restrained to the main by anchoring tees or strapping. Where this is not possible, restraint shall be provided as directed by the Commissioner. Plugs or caps at the end of branch piping shall be buttressed.

In addition to "strapping" the following elements of thrust restraint may be used with mechanical joints and ductile iron pipe. See Drawings No. 13, 14, and 15.

A. "Tiebolts", "Tie Couplings", "Tie Nuts", and "Tie Rods" as manufactured by Star National Products of Columbus, OH

B. "Megalug" M.J. ductile iron special gland and lugs as manufactured by Ebba Iron Inc. of Eastland, TX. Where "Megalugs" are used, wherein the pipe spigot is gripped by the Megalug, the pipe spigot shall be considered restrained.

The Megalug lugs shall be encapsulated with an approved encapsulating compound, "Duxseal" as manufactured by Johns-Manville Corp. or an approved equal material not harmful, to the rubber gaskets.

5.3.20 Construction of Manholes

Manholes shall be constructed at the locations and of the type shown on the Drawings. The City will furnish the manhole frames, covers and steps. The Contractor shall furnish all other materials. All materials shall conform to the applicable sections of Part 4 unless otherwise noted.

The manhole base shall be poured on firm soil. Where stable soil is encountered, but the soil is soft and wet, an additional depth of not less than 3 inches shall be excavated and replaced with ¾ inch bedding stone at no cost to the City. Where the soil is unstable, the Contractor shall remove the unstable soil and replace it with 2½ inch crushed stone. Where unstable soil in excess of 3 inches is encountered, and the Commissioner directs its removal and replacement, the Contractor will be paid at the Supplemental Schedule of Fixed Prices. The manhole base shall be constructed with Class "D" con-

crete with a minimum thickness of 8″ unless otherwise noted.

The manhole walls shall be constructed to the configuration shown in the Drawings. Unless otherwise noted, the walls may be constructed of brick, concrete block, precast concrete or monolithic concrete. All manhole materials shall conform to the requirements of Chapter 4.4.0. Monolithic manholes shall be constructed of Class "C" concrete. The joints for precast concrete manholes shall be constructed of either cement mortar, rubber gaskets, or approved flexible plastic gaskets. Other materials may be used provided they are specifically approved by the Commissioner.

Brick manholes shall be constructed such that the brick is laid flat, with the long dimension tangent to the manhole wall except for each fifth course laid shall be a header or binder course. The wall thickness shall be 8″ to a maximum depth of 18 feet unless otherwise noted. The depressions in the brick shall be laid upward. Brick shall be laid with full, shoved joints of standard cement mortar, and the inside joints shall be tooled. Vertical joint shall be broken. The outside face of the manhole shall be back-plastered with a smooth coat of mortar, ½ inch thick. The inside of the manhole and pipe shall be cleaned of mortar. All debris shall be removed from the manhole, and from the adjacent trench before backfilling.

Where concrete block are used, the above requirements shall be met, except that the block shall be laid without the header and the wall thickness shall be 6 inches to a depth of 12 feet unless otherwise noted.

Concrete block or brick shall be clean, dry and free from frost when they are laid. The Commissioner will reject any block or brick which is unfit for use.

Unless otherwise noted, the top of the manhole frame shall be set flush with the existing or pavement surface or established grade.

When manholes are built in temperatures below 35° F, the ingredients of the mortar at placement shall have a temperature of not less than 60° F and not more than 90° F. The block and brick shall be warmed to the same temperature range. The manholes shall be enclosed and heat furnished inside to prevent freezing for a minimum

period of 24 hours.

The manhole shall be constructed so that it is completely stable with an annular opening around the pipe. The annular space shall be approximately two inches around the complete perimeter of the pipe. The annular space shall then be closed with a high density closed cell rubber type material approved by the Commissioner. The material shall not become brittle or deteriorate with age.

This space shall be made watertight as follows: The rubber material shall be cut back one half inch on the inside and outside of the manhole wall and the opening sealed on both sides with a thick layer of "Duxseal" as manufactured by Johns-Manville Corp. or approved equal. The mastic shall be beveled from the pipe to the wall above the opening on a 45° angle to the pipe.

5.3.21 Air Vents

The Contractor shall install air vents at the locations shown on the plans in accordance with Drawings No. 29 and 30. The cost of furnishing and installing air vents shall be included in the unit price bid for installing the water main.

The Contractor shall furnish all material except as noted on the Drawings.

5.3.22 Blow-Off Drains

Blow-off drains on distribution mains shall be installed where shown on the plans in accordance with Drawing No. 31. The cost of furnishing and installing blow-off drains in distribution mains shall be included in the bid price for installing water mains.

Blow-off drains on feeder mains shall be installed where shown on the plans in accordance with Drawings No. 24, 25, or 26. The type of blow off to be installed will depend on the size, type and location and will be described on the plans. The cost of installing shall be included in the bid for installing feeder main unless otherwise noted on the bid documents.

5.3.23 Blow-off Disconnects

A number of feeder mains were installed with blow-

off drains at the low elevations which were connected to storm sewers. Blow-Off Disconnects consist of abandoning the blow off piping from some point to the sewer. The details of the piping alterations are shown on the plans. The revised blow off will terminate in a Riser Pipe Blow-Off as shown on Drawing No. 25.

After the pipe is abandoned, the sewer manhole opening and the open end of the cut water main shall be bulkheaded as hereinafter specified for "Abandoned water main."

Unless otherwise noted, payment for this work will be in accordance with the lump sum bid for "Blow-Off Disconnect."

5.3.24 Flotation

On all pipe previously installed, sufficient bedding and backfill or other restraining means shall be placed to prevent flotation due to an open trench or tunnel that may become flooded. Any pipe that has floated shall be removed and relaid as directed by the Commissioner.

CHAPTER 5.4.0 JOINTS — LEAD

5.4.1 Use of Poured Lead Joints

Poured lead joints shall be used where required by the plans and where necessary for connection to existing lead jointed water main or branches. In general its use is limited to locations where rubber gasket joint materials cannot be used. The cost of lead joints shall be included in the bid price for installing the water main and/or appurtenances.

5.4.2 Dry Condition Required

Lead joints cannot be poured if water is present in the joint opening. Temporary dikes or clay dams within pipe or fittings 24″ or larger to prevent water from entering the joint shall be removed immediately after pouring the lead. On smaller mains, rubber yarning material shall be used if necessary to exclude water from the joint.

The water level within the trench shall be kept below the bottom of the pipe when lead joints are being made.

5.4.3 Air Temperature — Minimum — Lead Joints

When air temperature is below 10 degrees Fahrenheit, the Contractor shall not install lead joints without special permission of the Commissioner.

5.4.4 Preparation of Bell and Spigot

The Contractor shall clean the bell and spigot of any loose or adhering extraneous material. The bell and spigot shall be kept clean and dry until the lead joint is made. When air temperatures are below 35 degrees Fahrenheit, the contractor shall, before pouring lead, carefully heat the bell and spigot until warm to prevent premature chilling of the lead. Extreme care shall be taken not to apply excessive heat sufficient to affect valve or hydrant seats.

5.4.5 Placing of Yarning Material

After spigot is centered in the bell and pushed back, the yarning material shall be driven against the inside base of the bell with suitable yarning tools. Yarning material of various cross section diameters should be available so that the diameter used will produce a tight fitting back seal for the lead pour. Driving the material shall start at the bottom of the joint and proceed upward to the top producing an overlap of the two ends of not more than two inches.

If the depth of joint requires more than one strand to produce the proper depth of lead, ends of the individual lengths shall butt together and the butt joint of the lengths shall be staggered approximately 90 degrees apart.

5.4.6 Yarn and Lead — Tabulations

Amounts shown in the following table are calculated for each size of pipe joint for bell and spigot pipe.

Pipe Diameter Inches	Depth of Bell Inches	Minimum Length of ½" Yarning material per Lap Ft.—Inches	Minimum Depth of Lead Inches	Approximate Weight of Lead Pounds
6	3.5	2— 2	2.25	11
8	4.0	2—10	2.25	14
12	4.0	2—10	2.25	20
16	4.0	5— 2	2.25	33
20	4.0	6— 6	2.25	40
24	4.0	7— 8	2.50	52
30	4.5	9— 6	2.50	65
36	4.5	11— 3	2.50	77
42	5.0	13— 0	3.00	104
48	5.0	14—10	3.00	119
54	5.5	16— 6	3.00	146

Unless otherwise permitted by the Commissioner, each joint shall have at least ¼" of annular space between the outside barrel of the spigot and the inside of the bell.

5.4.7 Positioning of Joint Runner

A damp runner shall be fitted snugly against the face of the bell and outside of the spigot. The ends of the runner shall be clamped at the top of the pipe forming an opening. A clay dam shall be formed around this opening extending upward to the outside top of the bell to create a gate in which to pour the molten lead.

5.4.8 Heating and Pouring Lead

Lead shall be heated in a melting pot kept near the joint to be poured. It shall be brought to the proper temperature indicated by a rapid change of color when stirred. Before pouring all scum shall be removed. The melting pot shall hold enough lead to insure a continuous and complete pour of the joint including the pouring gate.

Pouring the lead shall be continuous except for momentary delays to permit smoke and steam to clear. The lead shall be brought up to the top of the pouring gate, stopped momentarily to allow boiling to subside and then continued until the lead is level with the top of the gate. The Contractor shall burn out and repair rejected joints.

5.4.9 Caulking

The joint runner shall be removed after the lead has solidified. A certified caulker shall then caulk the joint. All joints shall be caulked with a pneumatically powered tool. The pneumatic tool shall be maintained in proper working order and shall be operated from a compressor having a minimum working pressure of 60 psi.

The caulker shall thoroughly compact the lead to make a tight joint. He shall lift the lead fillet from the spigot pipe with a chisel tool and drive the lead into the bell with successively larger properly proportioned flat faced caulking tools until it becomes solidly compacted. The lead gate shall not be cut off by chisel but be cut loose from the lead joint as the successively larger tools are used. The finished joint shall show a hard and evenly hammered surface.

5.4.10 Direction of Installation

Normally lead joint water main shall be installed with the bells facing the direction of installation. If the grade is greater than 5%, the joints shall face up-grade.

CHAPTER 5.5.0 JOINTS — PUSH-ON RUBBER GASKET

5.5.1 Design of Joints

Each manufacturer furnishes gaskets for its joint design. The gaskets are not interchangeable for use in joints of other manufacturers and no substitution of gaskets will be permitted.

5.5.2 Joint Lubricant

Only vegetable based lubricant furnished by the pipe manufacturer shall be used. The lubricant container shall be labeled with the trade name or trade mark and the pipe manufacturer's name. The lubricant shall contain no materials that are considered toxic for potable water in accordance with the regulations of the U.S. Environmental Protection Agency.

5.5.3 Minimum Air Temperature

When air temperature is below 10 degrees Fahrenheit, the Contractor shall not install rubber gasket jointed water mains without special permission from the Commissioner.

When the air temperature is below 32 degrees Fahrenheit, the gasket and the lubricant shall be warmed to keep the gasket pliable and the lubricant in a workable consistency.

5.5.4 Preparation of Spigot

All spigots shall be chamfered and free of burrs or sharp edges that may cut the gasket. Full length pipe is supplied with a chamfered spigot. On all cut pipe, the Contractor shall chamfer the outside edge a minimum of ⅛" on the vertical at an angle of about 30 degrees with the center line of the pipe.

5.5.5 Procedure for Assembly

The inside of the bell shall be inspected for casting burrs. The bell, spigot and gasket shall be clean and dry prior to assembly. Any casting burrs, excess coating or foreign matter shall be removed. The presence of casting burrs or foreign matter on the contact surfaces is likely to result in a joint leak.

The rubber gasket shall be inserted into the groove within the bell with the flat surface of the gasket within the groove and the nose of the gasket toward the outside end of the bell.

Both the spigot and the gasket shall be thoroughly lubricated before the spigot is centered and inserted into the bell. The centerline of the spigot and bell shall be pushed until it comes into contact with the base of the bell and then backed off ⅛" to break contact between the spigot and bell.

If a back-hoe bucket is used to drive the spigot home, a timber header shall be placed between the bucket and the pipe to prevent damage to the pipe. Care shall be exercised not to drive the spigot home with such force as to eliminate the ⅛" gap in previously laid pipe.

Any deflection of the pipe shall be made after the joint is assembled.

CHAPTER 5.6.0 JOINTS — MECHANICAL — RUBBER GASKET

5.6.1 Design of Mechanical Joint

The standard American Water Works Association mechanical joint has four parts: A flange cast integral with the bell of the pipe or fitting; a rubber gasket fitting a recess in the bell; a gland or follower ring to compress and retain the gasket; the nuts and bolts for tightening the follower ring and compressing the gasket.

The rubber gasket used for the joint shall be furnished by the manufacturer. The spigot end of centrifugally cast push-on or lead joint pipe may be used in mechanical joints.

5.6.2 Preparation of the Components

Any sharp edges, casting burrs or foreign matter on the bells, spigot or gasket shall be removed. A bevel is not required on the spigot. However, care should be exercised to assure that a sharp edge at a cut does not contact the gasket.

5.6.3 Assembly

The bell, gasket and spigot shall be wiped clean of all sand and dirt and any excess coating in the bell removed. The gland then is placed on the spigot with the lip extension toward the spigot end of the pipe, followed by the gasket with the narrow edge of the gasket toward the end of the pipe.

The spigot is pushed into the bell and the gasket pressed firmly and evenly around the entire bell. The gland is then pushed against the gasket. Glands for larger diameter pipe may require wedging to center the gland on the gasket. The bolts shall be tightened oppositely in increments to assure the gland bearing on the gasket is uniform. This procedure shall be repeated until all bolts are tightened to the range of torques listed below.

Bolt Size-Inches	Torque-Ft. Pounds
5/8	45 - 60
3/4	75 - 90
1	100 - 120
1 1/4	120 - 150

The Contractor shall have a torque wrench or gauge available on the site for the use of the representative of the Commissioner to measure the torque applied to the joint bolts to insure compliance with the requirements of this table.

Any required deflection of the pipe shall be made after assembly of the joint, but prior to tightening the bolts to ensure the proper final deflection. After the pipe is deflected, the bolts shall be carefully tightened.

CHAPTER 5.7.0 JOINTS — PRESTRESSED CONCRETE PIPE — RUBBER AND STEEL

5.7.1 Pipe and Joint Design

All pipe and joint design and layout drawings shall be submitted for approval in accordance with the WED Specification for Prestressed Concrete Pipe. (For allowable field repairs see Section 5.3.6)

5.7.2 Protection of Rubber Gaskets

The Contractor shall protect rubber gaskets against extremes of temperature, prolonged exposure to direct sunlight, grease, oil, or other petroleum derivatives, cuttings or abrasions. Damaged or deteriorated gaskets shall immediately be removed from the job site.

5.7.3 Joint Lubricant

The steel joint rings and rubber gasket shall be lubricated with a lubricant approved by the Commissioner. The lubricant container shall be labeled with the trade name or trade mark and the pipe manufacturer's name. The lubricant shall contain no materials that are considered toxic for potable water in accordance with the regulations of the U.S. Environmental Protection Agency.

5.7.4 Temperature

The steel joint rings and the rubber gasket shall be warmed prior to assembly of the joint when air temperature is below 32 degrees Fahrenheit. The lubricant

shall be kept at a temperature sufficiently high to maintain it at a workable consistency.

5.7.5 Assembly of Joint

All components of the joint shall be carefully cleaned at the time of assembly after the pipe has been lowered into the trench. The gasket shall be installed in the gasket groove on the spigot end of the pipe and checked to assure it is positioned properly without twisting. The joint rings and gasket shall then be liberally coated with the lubricant. The spigot end with the gasket in place shall then be carefully pushed into the bell of the pipe already laid to within approximately one inch of metal to metal contact. At this time, steel spacers the thickness of which shall be equal to the gap specified on the approved drawings shall be placed in the one inch opening. The pipe shall now be drawn up against these spacers. A "feeler gauge", supplied by the manufacturer, shall be used to determine the position of the gasket around the complete perimeter of the pipe. If the gasket is found to be out of position, the pipe shall be withdrawn and the gasket shall be removed and destroyed. The gasket shall be replaced and the assembly procedure shall be repeated. If the gasket is found to be in the proper position, the spacers shall be removed and the pipe drawn "home". At this time, the final line and grade shall be set. The maximum deflection of the pipe is tabulated in Drawing No. 1.

The Contractor shall not use a method of forcing the pipe home that will place undue stress on the steel rings or the gasket, or cause movement in the previously installed pipe or fittings.

The Contractor shall remove all shipping struts after pipe assembly.

5.7.6 Maximum Joint Deflections

The joint deflection for straight or beveled pipe lengths shall not exceed that created by the following joint openings.

24″	30″	36″	42″	48″	54″	60″
5/8	5/8	5/8	5/8	3/4	7/8	7/8

Joint openings greater than these can only be used with express approval of the Commissioner.

5.7.7 Tied or Special Joints

All tied or special joints must be shown on the drawings which are submitted for approval. Joints not included in the approved drawings shall not be used.

The Commissioner shall approve the method of installation of tied joints or special joints. Welders used to assemble these joints shall be experienced and certified and approved by the Commissioner.

5.7.8 External Joint Protection

After the pipe has been jointed, a band at least 5½ inches wide shall be placed around the complete exterior of the pipe over the joint. This band shall be of cloth, or other suitable material, with wire or steel straps sewed along each side to facilitate attaching to the pipe. The band will serve as a form for placing a mortar slurry in the external recess of the joint. After the band is in place, the Joint Assembler shall pour slurry into the top opening completely filling the void. Careful backfilling, guarding against ripping the band, may proceed immediately. If the temperature is below 35 degrees Fahrenheit, the Contractor shall immediately protect the joint and backfill the trench at the joint to a minimum of one foot over the pipe with specified unfrozen backfilling material. The mortar shall consist of one part cement to two parts mason sand.

Other methods of filling the external void may be permitted if recommended by the pipe manufacturer and approved by the Commissioner.

5.7.9 Internal Joint Protection

The internal joint void of the last 5 joints before closure, cap, or plug and the adjacent 5 joints on each side of a valve shall be filled with a 1:2 cement mortar. Remaining joints shall not be filled.

When the pipe is installed at temperatures below 35° F, the ingredients of the mortar at time of placement shall have a temperature of not less than 60° F nor more than 90° F. If necessary the ends of the pipe shall be heated to assure the mortar does not freeze.

CHAPTER 5.8.0 JOINTS — POLYVINYL CHLORIDE PIPE RUBBER GASKET

Chapter 5.8.1 Design of Joint

P.V.C. water pipe has the same outside diameter as ductile iron and centrifugally cast grey iron pipe. Therefore, a P.V.C. spigot will fit and can be used with push on or mechanical joint fittings.

All pipe shall be of bell and spigot design only. The rubber gasket for a P.V.C. joint is designed by each pipe manufacturer to be used only in that manufacturers bell. There shall be no substitution of gaskets. Only P.V.C. spigots are to be connected to P.V.C. bells.

5.8.2 Joint Lubrication

The spigot is to be lubricated prior to insertion into the bell. The bell and gasket are not to be lubricated.

Only the lubricant furnished by the pipe manufacturer shall be used. The lubricant container shall be labeled with the trade name or trade mark and the pipe manufacturer's name. The lubricant shall contain no materials that are considered toxic to potable water in accordance with the regulations of the U.S. Environmental Protection Agency.

5.8.3 Air Temperature — Minimum — P.V.C. Pipe

When air temperature is below 10 degrees Fahrenheit, the Contractor shall not install P.V.C. pipe without special permission from the Commissioner.

When the temperature is below 32 degrees Fahrenheit, the gasket and lubricant shall be warmed to keep the gasket pliable and the lubricant in a workable consistency.

As temperatures approach and drop below 32 degrees Fahrenheit, the flexibility of P.V.C. pipe is reduced. Extreme care should be used in handling the pipe during cold weather.

5.8.4 Cutting

Pipe shall be cut at right angle to the axis of the pipe

with a fine toothed hand saw, a mechanical saw with a fine toothed blade or mechanical saw with an abrasive disc.

All spigots to be assembled into a P.V.C. bell shall be chamfered by hand file or mechanical means to an 8 degree angle, ±1 degree, to the center of the pipe. The leading edge shall not be less than ¼ inch. Pipe being connected to a push-on joint ductile iron fitting or valve shall be chamfered as for ductile iron. Pipe being assembled into a mechanical joint need not be chamfered.

5.8.5 Procedure for Assembly

Full lengths of P.V.C. pipe are marked with a reference line to indicate the proper depth of insertion of the spigot into the bell. Cut spigots shall be marked with a reference line at the following dimensions from the end:

Pipe Diameter	4″	6″	8″	10″	12″
Mark from the end	4.50″	5.25″	6.00″	6.75″	7.50″

The chamfered spigot, gasket and bell are to be cleaned of any dirt or foreign material. Spigots shall be smooth and free of cuts, gouges, abrasions or other surface defects.

Gaskets for P.V.C. pipe are color marked to show direction of insertion into the bell groove(s). When placing the gasket into the bell groove, this marking shall face toward the face of the bell. After installing the gasket, the spigot shall be lubricated and inserted into the bell to the proper depth as indicated by the reference mark. The mark shall be flush with the face of the bell.

Assembly of P.V.C. pipe into iron fittings or valves shall conform to the requirements of Chapters 5.5.0 and 5.6.0. The gap between the end of the spigot and the "home" of the bell shall be ⅛″.

5.8.6 Deflections in Line and Grade

Deflections in P.V.C. water mains shall be accomplished by bending the pipe, not by deflecting the pipe at the joints. P.V.C. joints cannot be broken to provide deflection or offsets. When deflecting a P.V.C. pipe line, the joints shall be rigidly restrained by stakes or other means. The pipe shall then be pulled over by hand to

the required offset within the following maximum limits per 20′ length:

Pipe Diameter	4″	6″	8″	10″	12″
Maximum Offset	12.0″	4.0″	3.0″	2.5″	2.0″

5.8.7 Services or Branches on P.V.C. Pipe

Due to the high rate of expansion of P.V.C. pipe, after installation each copper service shall be completely wrapped with a layer of closed cell foam rubber not less than ½″ thick. The wrapping shall extend from the O.D. of the pipe to not less than 1.5 feet from the pipe. The wrap shall be carefully held in place by a suitable approved method.

Branch piping shall be similarly wrapped from the pipe to the enlargement of the valve casting or 1.5 feet whichever is smaller.

5.8.8 Thrust Restraint

Metal joint restraining materials shall not be used in direct contact with P.V.C. pipe because of the soft nature of the pipe material. Thrust restraints which are connected to iron fittings at each end may be used.

All thrust restraint shall be achieved by installing concrete buttresses installed in such a manner as to prevent gouging or otherwise deforming the surface of the pipe.

CHAPTER 5.9.0 JOINTS — COPPER PIPE

5.9.1 General

Joints shall be made by assembling the two ends of plain end pipe into a coupling designed for Type "K" copper and silver brazing. The silver brazing alloy shall conform to the requirements of ASTM E56. Joint preparation and brazing procedure shall be as recommended by the manufacturer of the brazing alloy. This type of joint shall be assembled by personnel certified to braze copper joints.

CHAPTER 5.10.0 POLYETHYLENE ENVELOPE

5.10.1 General

Two layers of polyethylene tube or sheet envelope shall be installed on all ductile and grey iron water main material.

Care shall be exercised during the application to prevent excavated or backfill material from entering the envelope so as to contact the pipe. Any foreign material inside the envelope shall be removed. Small amounts of water trapped within the envelope need not be removed.

The polyethylene envelope shall be neatly folded and taped around the outside layer to provide a moderately close but not tight fit. All sags and pockets shall be eliminated so that the polyethylene is not punctured by the bedding material. In cold weather, the adhesive tape may not adhere. In this event, after 2 or 3 circumferential tape wraps, the end of the tape shall be tied together.

Where placing bedding material over and around the pipe, care shall be taken to prevent damage to the envelope. Any damage shall immediately be repaired.

5.10.2 Application to Water Pipe, Hydrant Branches and Service Branches

Polyethylene tubing or sheets shall be cut at least 2 feet longer than the piping to be enveloped. When placed on the pipe, the material shall envelope each end. It shall be neatly snugged against the barrel of the pipe and taped at 3 to 5 foot intervals. After assembly of a joint, the ends of envelope at the bell shall be drawn over the bell, snugged and taped securely in front of and behind the bell. There shall be enough play over the bell to prevent cutting of the material when bedding is placed.

The second layer shall be installed similar to the first layer but shall overlap the first layer at each end by not less than one foot.

Hydrant branches and service branches shall also be

encased in two layers of polyethylene. On hydrant branches, the envelope shall cover the bell on the hydrant shoe, but shall not cover the drain hole.

5.10.3 Application to Fittings, Valves and Metal Joint Restraints

An additional layer of polyethylene film shall be installed on all mechanical joint fittings. This layer shall be installed prior to the other wraps and shall be in intimate contact with the flange and follower gland and tucked under the bolt heads and nuts. The wrap shall extend not less than 12 inches beyond the ends of the bolts.

All metal joint and thrust restraints shall be installed under the polyethylene wraps insofar as possible. Two additional layers of polyethylene shall be placed as a protection over protruding edges to prevent cutting the required two wraps under the weight of the backfill. The polyethylene wrap shall be installed in intimate contact with pipe straps and thrust rods to prevent subsequent puncture.

Where polyethylene film cannot satisfactorily be placed over thrust restraining material, the material shall be encapsulated in plastic roofing cement or Kopper's No. 50 in accordance with Section 5.3.19.

In all cases, the contractor shall inform the Commissioner's representative of the manner in which the thrust restraining material is to be installed and protected. The exact details of this operation must be approved before the installation approaches the location requiring thrust restraint.

When placed around caps or plugs, the envelope shall completely cover the unit. If an air-vent is present, the envelope shall be taped around the air-vent piping. However, the valve operating nut shall be left clear and accessible through the valve box.

5.10.4 Openings in Envelopes for Service Taps

When corporation stops are to be installed on a main with polyethylene envelope, the envelope shall be neatly cut and drawn back to permit the use of the tapping machine. After tapping, the existing envelope material shall be brought back over the pipe and taped. A new

piece of polyethylene wrap at least 3 feet wide, centered on the cut in the original envelope and covering the entire circumference of the pipe shall be placed and taped. The envelope shall be snugged and taped around the corporation stop.

5.10.5 Services

Copper water services, including corporation stops shall be encased in polyethylene envelope from the water main for a distance of six feet or to the face of the excavated trench wall.

When a water service is to be connected to a water main installed without a polyethylene envelope, the exposed area of installed main, with a minimum of 2′ centered on the corporation stop, shall be cleaned and wrapped with polyethylene as though it were new pipe.

5.10.6 Connections to Existing Water Mains

When a new main is being connected to a water main installed without a polyethylene envelope, the envelope on the new main shall extend to include all of the exposed pipe as though it were new pipe. The old pipe shall be cleaned as required.

When connecting to a main previously enveloped, the exposed envelope on the old main, if in good condition, shall be pulled back to facilitate the connection. If the envelope is in poor condition, it shall be removed and replaced within the limits of the excavation.

5.10.7 Repair Procedures

Any dirt or other foreign material shall be removed from within the envelope and from the surface of the pipe before proceeding with the repair.

Minor tears or punctures in the polyethylene envelope may be repaired by bringing the torn parts together and sealing the tear or puncture with the adhesive-backed tape. The envelope material shall not be stretched to bring the parts together but should be relatively loose after the repair is made.

Larger tears shall be repaired by bringing the torn edges as close together as possible without stretching the material. A piece of polyethylene material shall be

centered over the repair area with a minimum of 6″ overlap in all directions. The entire repair patch shall be carefully taped to make it as secure and water tight as practical. The patch shall extend over and around the top of the pipe to shed water.

CHAPTER 5.11.0 INSULATION OF WATER MAINS AND APPURTENANCES

5.11.1 Required

Insulation against freezing shall be installed when indicated on the plan(s), when the water distribution main, branch or service has less than 5 feet of cover, or when directed by the Commissioner. See Drawing No. 37.

5.11.2 Types of Insulation

A. Rigid Insulation — Two layers of closed cell extruded polystyrene foam boards 4′ x 2′ x 2″ minimum. This type will be considered the standard unless otherwise indicated.

B. Insulating concrete — Perlite or Vermiculite concrete encasement or cover. The concrete shall have a mix ratio of 1 part portland cement and 8 parts perlite or vermiculite.

This type may be substituted for type "A" only with the approval of the Commissioner.

5.11.3 Installation — Type "A" — Rigid Insulation

A. The trench shall be excavated to the width required by the rigid board insulation.

B. The bedding chips shall be covered with mason sand beneath the insulation board and be hand spread and compacted by suitable mechanical means to provide uniform support for the insulation board. The insulation board shall be laid flat, free of any breaks or cracks.

C. All joints of the insulation board shall be staggered not less than one foot joint to joint.

D. Mason sand shall be hand spread to not less than one foot over the insulation board and compacted by suitable mechanical means prior to backfilling.

E. Insulation board shall be closely fitted around all valves and service boxes.

5.11.4 Installation — Type "B" — Insulating Concrete

A. Insulating concrete shall be machine mixed.

B. When permitted by the Commissioner, insulating concrete may be substituted for insulation board at the ratio of 4″ of concrete to 2″ of board. The area covered shall be at least equal in all dimensions to that indicated for the rigid insulation.

C. When used for insulating water services, see Drawing No. 6 of the Water Service Piping Specifications.

5.11.5 Payment

When the plans require insulation the cost shall be included in the contract unit price bid for the water mains, branch or service.

When ordered as an extra by the Commissioner for a change of grade which reduced the cover to less than 5 feet, the insulation shall be paid for in accordance with Chapter 2.6.0.

CHAPTER 5.12.0 TUNNELING, JACKING AND BORING

5.12.1 Wisconsin Administrative Code Compliance

On all shaft and tunnel work, the Contractor shall comply with the requirements of the Wisconsin Administrative Code. Specific additions thereto as may appear in the plan(s) and in Chapter 5.9.0 of the Sewer and Building Services specification shall govern when they exceed the requirements of the Code.

5.12.2 Tunnel Design Changes

Revisions or alterations will not be allowed without written approval of the Commissioner. When deviations are approved, they shall be in accordance with plans previously submitted by the Contractor and approved.

Approval of revisions or alterations shall not affect the compliance with any requirement of these specifications or the Administrative Code.

5.12.3 Installation of Pipe in Tunnel

Distribution mains installed in tunnel shall be installed as in open cut construction including the polyethylene envelope.

Feeder mains installed in tunnel shall be installed on rails or steel piping. The rails or piping are to be set to a line and grade such that when the pipe is placed it shall be on plan line and grade. The rails or piping shall be anchored to the tunnel structure to prevent lateral or horizontal movement during pipe installation. The space between the rails or pipes shall be filled with concrete grout just prior to sliding the pipe into position. When in position, the pipe shall be in contact with the grout for its entire length.

All ductile iron mains shall be wrapped in the polyethylene film envelope. The pipe shall bear on wearing skids attached outside the polyethylene envelope.

Water main installed in tunnel shall have the first rubber gasket joint outside the tunnel located approximately two feet outside each end of the tunnel.

5.12.4 Tunnel and Tunnel Shaft Backfill

Unless otherwise indicated in the plan tunnels shall be backfilled with backfill concrete or light weight cellular concrete.

Unless otherwise indicated work and manhole shafts shall be backfilled with Type "B" gravel and flooded as required.

Costs of backfilling shall be included in the unit price bid for the tunnel or water main.

5.12.5 Boring Without Steel Casing Pipe — Mains

Boring without a casing pipe shall be limited to a maximum 18 feet in length with no water pipe joint permitted within the bore. See Drawing No. 33.

Boring under traveled roadways or other obstructions shall be done when so indicated on the plan(s) or when permission is requested in writing by the Contractor and approved by the Commissioner.

Alignment of the completed bore shall be within 6 inches of line and grade. Misalignment greater than this shall be corrected. The contractor shall assume the cost of any such corrections.

When a bore is used the water main shall have a rubber gasket joint located a minimum of 1 foot but not more than 2 feet outside the ends of the bore. The polyethylene envelope shall be protected by skids attached to the outside of the pipe or other approved means.

The bore shall be backfilled with backfill concrete or light weight cellular concrete.

5.12.6 Boring with Steel Casing Pipe — Mains

Boring with steel casing pipe shall consist of pushing or jacking a casing pipe simultaneously with mining operations. Final alignment of the casing pipe shall be within 6 inches of the line and grade shown on the plans.

Water main installed in a casing pipe shall have the first rubber gasket joint located not more than 2 feet outside each end of the casing pipe. See Drawing No. 34.

When required on the plan, the Contractor shall place a 12″ concrete bulkhead at each end of the casing pipe. The cost of bulkheads shall be included in the price bid for casing installation. See Drawing No. 35.

The Contractor shall backfill within the casing with light weight cellular concrete. Any other method of backfill shall be approved by the Commissioner.

5.12.7 Payment of Tunneling, Boring, Jacking

Payment for tunneling, boring, or jacking when listed as a bid item, shall be based on actual field measure-

ment with maximum dimensions as shown on the plan unless an additional length is ordered in writing by the Commissioner. Additional lengths shall be paid for at the bid unit price for tunneling, boring, or jacking.

Minor tunneling and/or boring and jacking will not be a bid item. The cost shall be included in the unit price bid for doing the water main work.

Any tunneling, boring, or jacking done by the contractor for his convenience shall be at his own expense.

CHAPTER 5.13.0 CONCRETE WORK

5.13.1 Class of Concrete

All monolithic concrete shall be Class D concrete, unless otherwise indicated on the plan(s). All buttresses, anchors, and bases shall be Class F concrete, unless otherwise indicated.

See Section 4.5.1

5.13.2 Forms for Concrete

Trench sheathing may be used as the outer face form. If trench sheathing is used, the inner form shall be substantially braced against it. When outer forms are constructed, the contractor shall brace them against the trench face and bind them to the inner form with tie rods. When approved by the Commissioner they may be bound by wire ties with wooden spreaders.

Forms for exposed inner faces of walls and top slabs shall be faced with dressed timber. The size and spacing of studs, walers, shores and braces shall be adequate to insure the safety and rigidity of the structure throughout the pour.

5.13.3 Steel Reinforcement

Steel reinforcement for concrete bases, beams and buttresses shall conform to the specification A.S.T.M. Designation A615 for grade 40 or grade 60 billet-steel deformed bars. Dowels shall also be deformed bars except as required for pavement joints.

Steel reinforcement shall be free from loose rust scale or other coatings that would destroy or reduce bond.

The Contractor shall space bars in accordance with the details shown on the Drawings and shall tie 50% of the crossings of reinforcing bars. The reinforcement mat shall be held in correct position by chairs, spacers, wire ties or other positive positioning devices. Wooden block supports shall not be used. Where it is necessary to splice reinforcement, the bars shall be lapped at least 24 diameters, but no less than 12 inches in any case.

Reinforcing steel located on the outer faces of a structural slab or buttress shall be installed with not less than 1½" nor more than 2" of cover from the outer face of the concrete.

5.13.4 General Methods of Concrete Placement

Concrete may be deposited into forms by any of the following methods:

(A) By shovel, barrow or buggy, chute, or concrete bucket; when any of these methods are used for reinforced concrete construction no displacement of the reinforcement mat or of the individual bars will be permitted. An open chute may be used only when its use does not cause segregation of the concrete.

(B) By pumping, where concrete is conveyed by means of mechanically applied pressure. The operation of the pump must produce a continuous flow of concrete, free of air pockets. The Commissioner may reject the use of equipment which is considered unsuitable or inadequate.

(C) When concrete is placed by hand in tunnel, it shall be thoroughly remixed prior to placement into forms.

5.13.5 Precautions in Placing Concrete

Concrete shall be conveyed from the mixer or ready-mix truck to the place of final deposit by methods which will prevent the segregation or loss of materials. Concrete shall be deposited in its final position to avoid segregation due to excessive vibrating or rehandling.

The concreting shall be carried on at such a rate that the concrete remains workable and flows readily into the spaces between reinforcing bars.

No concrete that has excessive slump, has partially set or been contaminated by foreign material shall be deposited in the work nor shall retempered concrete be used.

When concreting is once started, it shall be carried on as a continuous operation until the placing of the section is completed. Concrete shall be mechanically vibrated, as it is deposited, in order to avoid formation of seams within the section and to insure intimate jointing of each layer. Care shall be taken to insure the complete embedment of the reinforcement.

5.13.6 Protection of New Concrete

(A) Cold Weather Concreting — Adequate equipment shall be provided for heating concrete materials and protecting concrete when the temperature is below 35 degrees. No frozen materials or material containing ice and snow shall be used. All reinforcement, forms, fillers, and ground with which the concrete is to come in contact shall be free from ice and snow. All concrete placed in forms shall have a temperature of 60 to 90 degrees F at the time of placement. On all monolithic concrete work, the Contractor shall furnish 2 maximum-minimum thermometers for the use of the inspector assigned to the work. Adequate means, such as covering with thermal blankets, canvas, hay, straw, polyethylene film, or other protective covering shall be provided and the concrete maintained at a temperature of not less than 40° F for a period of 3 days.

(B) Hot Weather Concreting — In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays or other devices shall be provided as directed by the Commissioner. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump or flash set. Concrete shall be cured for a period of 3 days by spraying with water, backfilling after the concrete is set or by application of an approved curing compound.

5.13.7 Buttresses, Beams, Bases, Anchors and Thrust Collars

Buttresses, beams, bases, anchors and thrust collars of concrete are required as shown on the specification drawings. The concrete shall be founded upon firm soil and poured directly against the side of the fittings and the trench wall. The Contractor shall use forms against the trench wall only when the soil is unstable. These forms shall not be removed. The cost of all of the above shall be included in the unit bid price for installing the water main unless otherwise noted on the plan.

5.13.8 Detailed Monolithic Concrete Construction

Chapter 5.4.0 of the current City of Milwaukee Sewer and Building Service Specifications shall apply to monolithic concrete construction not detailed in the preceeding paragraphs.

CHAPTER 5.14.0 CONNECTIONS, REMOVALS AND ABANDONMENT

5.14.1 Work On Water Mains — Milwaukee Water Works Personnel

Milwaukee Water Works personnel will serve all necessary shut-off notices to customers, provide temporary service and operate valves on any water main within the Milwaukee Water Works system. In addition, on iron feeder mains, Milwaukee Water Works personnel will make any cuts in the pipe.

5.14.2 Work On Water Mains — By Contractor

The Contractor shall excavate, brace excavations, drain the water main, install water main material, assemble joints, backfill and on distribution mains, 16" and smaller, make any necessary cuts, remove piping material, burn out lead joints, sandblast sulfur compound joints to bare clean metal, and do any and all other work required for connections to or alterations of any in-service water main within the Milwaukee Water Works system.

On all cast iron and ductile iron feeder mains, 20″ in diameter and larger, the Water Distribution forces will make the necessary cuts on the water main. All other work including that described above required for connection to or alteration of the water main shall be performed by the contractor.

On concrete feeder mains, the contractor shall make the cuts required on the pipe required for closures.

The cost of all work shall be included in the contract bid prices for the Water Main.

5.14.3 "Cut-In" Valve or Tee

Where required in the plans, the Contractor shall install a "cut-in" valve or a tee in an existing water main. The existing pipe and all new pipe shall be carefully cut perpendicular to the center of the pipe. All projecting irregularities shall be ground off to provide a clean smooth end.

The "cut-in" valve or tee shall be a one sleeve or two sleeve assembly as shown on Drawing No. 32. In the two sleeve assembly, a short double spigot length of new pipe shall be connected into the bell on each side of the valve or tee. The out to out distance of the double spigots shall be carefully measured. The main shall then be carefully cut to the measured dimension plus ⅛″ maximum for valves and a maximum of ¼″ for tees and removed.

A standard or dual size mechanical joint coupling to fit the diameters of the mating pipe shall be placed over the existing pipe on each side of the joint. The double spigot assembly shall then be set in place with proper orientation and the couplings installed over the joints.

A one sleeve assembly must be made adjacent to an existing bell. A short double spigot length of new pipe is connected to each end of the "cut-in" valve or tee and the out to out dimensions of the double spigots are carefully measured. The main is then cut a sufficient distance from the bell to receive the assembly plus the depth of the existing bell plus ½″. The cut main is then removed from the existing bell. The standard or dual size mechanical joint sleeve shall then be placed over the existing pipe beyond the joint. The double spigot assembly shall then be set in position in the existing bell

remaining and the opening carefully measured. A filler piece shall then be cut to fill the opening with a maximum gap of ⅛ inch for valves and ¼" for tees. The sleeve shall then be carefully centered over the joint and the joints fully assembled.

The type of cut in valve or tee assembly shall be shown on the plans. The City may require the installation of lead joint sleeves instead of the mechanical joint type if so noted on the plans. The filler piece to be installed within a lead joint sleeve shall be adequately tack welded to an adjacent spigot.

The cost of installing a "cut-in" valve or tee may be a separate bid item or may be included in the bid price of installing the water main. The method of payment will be stated in the contract documents.

5.14.4 Handling Salvageable Water Main Material

The Contractor shall carefully remove and protect from damage all salvageable material that by this specification, the plan(s) or special provisions are to be returned to the City. Any such material damaged or broken due to the Contractors carelessness will be charged to him at the prevailing price of similar new material.

Any material removed from the excavation that is to be used on the contract shall be thoroughly cleaned and if ordered by the Commissioner, painted on the outside with a 30 mil coat of Kopper's "Bitumastic No. 50" prior to installation. The inside shall be painted with a 10 mil coat of Kopper's "Super Tank Solution".

Unless otherwise noted salvaged feeder main material shall be separated into the individual component parts by the Contractor. Valves shall be opened and drained of water. All salvaged material shall be returned to the City pipeyard by the Contractor.

5.14.5 Abandonment of Water Mains, Branches, Valves, Curb Stops, Hydrant Branches, Drains and Manholes

The Contractor shall install bulkheads in the open ends of all water mains, hydrant branches and drains, blow-off drains, and branch services that are to be abandoned. The minimum thickness of the bulkheads shall be 8 inches for branches, drains, and mains up to and

including 16″ in diameter, and 12″ for mains over 16″ in diameter.

Hydrant drains and blow-off drains connected to sewer manholes shall also be bulkheaded inside the manholes.

When valves or curb stops are to be abandoned, the Contractor shall remove only the top section of the valve or service box and backfill the remaining hole with gravel backfill. All valve and curb stop boxes on mains abandoned as part of the contract shall be abandoned in this manner.

The cost of abandonment shall include the cost of all necessary pavement or sod replacement.

5.14.6 Abandon Water Main

When the plans require a water main to be abandoned, the Contractor shall install bulkheads in the open ends of the section of water main to be abandoned. He shall install plug(s) or cap(s), where required, to reactivate the live water main. The Contractor shall cut a one foot piece out of the abandoned section, and set it aside for city use.

The cost of abandoning the water main, valves or curb stops, manholes, fire cisterns and appurtenances in accord with sections 5.14.5, 5.14.6, 5.14.11 and 5.14.12 shall be included in the unit price bid for water main installation unless there is a separate "Abandon Water Main" bid item.

5.14.7 Hydrant Removal — Minor

When a hydrant is to be removed and it is connected to an abandoned or to be abandoned water main, the Contractor shall remove the entire hydrant and bulkhead the open end of the remaining hydrant branch and drain, if any. He shall also abandon the hydrant branch valve, or tapping valve, if any.

Unless otherwise noted on the bid documents, the cost of the above work shall be included in the bid item for "Hydrant Removal — Minor".

The work is identified on the plan as a "H/rem/minor".

5.14.8 Hydrant Removal — Major

When a hydrant is to be removed and it is connected to a main that will remain in service and its branch is to be abandoned, the Contractor shall, in addition to the work required for "Hydrant Removal — Minor" excavate and plug the hydrant tee or cross and bulkhead the branch pipe. The bid item "Hydrant Removal Major" shall include the cost of plugging the hydrant tee or cross.

If the branch is connected to a tapping valve and sleeve, the Contractor, in addition to the work described above, except plugging the tee, shall excavate at least 3 feet to each side of the tapping sleeve completely exposing the main and sleeve so they will be ready for inspection. The Contractor shall remove the tapping valve and plug the sleeve if the City determined it is in good condition.

If the City determines that the water main, or tapping sleeve are in poor condition, the Contractor shall cut, remove, and replace that section of main. In addition to the bid item "Hydrant Removal Major" this work shall be paid for as an extra in accordance with Chapter 2.6.0.

This work is identified on the plan as a "H/rem/major".

5.14.9 Hydrant Relocation

There is no bid item for "Hydrant Removal" when an existing hydrant is to be removed and a new hydrant and hydrant branch is to be installed in the same excavation. The cost of removing the old hydrant branch pipe and the hydrant shall be included in the bid price for installing "Hydrant Branch" pipe or for installing "Hydrant."

5.14.10 Salvageable Hydrant

All hydrants dated 1950 and newer shall be returned to the City unless otherwise directed by the Commissioner.

5.14.11 Abandon Manhole

In abandoning a manhole the Contractor shall remove

the manhole frame and lid. The top of the manhole shall be removed to at least 3 feet below the street grade and the remainder of the manhole and excavation backfilled with backfill gravel and properly compacted. Any drains from the manhole shall be properly bulkheaded. "Abandon Manhole" is a bid item only if so listed on the plan(s).

5.14.12 Abandonment of Fire Cistern

The Contractor shall cut the cistern branch at the tee, insert a plug in the tee, and bulkhead the open end of the cistern branch. If the valve is outside of the excavation, it shall be abandoned with the branch. The Contractor shall remove the entire valve box if it is within the excavation, or top section only, if it is outside the excavation.

When the cistern is connected to a tapping valve and sleeve, the Contractor, in addition to the work described above, shall excavate at least 3 feet to each side of the tapping sleeve completely exposing the main and sleeve so they will be ready for inspection. The Contractor shall plug the outlet of the tapping sleeve if it is in good condition.

If the main, tapping valve, or sleeve are in poor condition the contractor shall cut out and replace the poor section of the main. The Contractor shall remove the sleeve, valve, and cut pipe from the trench. This additional work will be paid for as an extra in accordance with Chapter 2.6.0.

The cistern frame and cover shall be removed by the Contractor. The wall of the cistern shall be removed to at least 3 feet below the grade of the street and the drain to the sewer plugged with a proper bulkhead. If the drain is connected to a sewer manhole, the opening in the sewer manhole shall be bulkheaded. The entire excavation and the abandoned cistern shall be backfilled with backfill gravel and properly compacted.

5.14.13 Removed Air Vent Materials

All materials comprising existing air-vents as well as material furnished by the City for temporary air-vents remain the property of the City and shall be delivered to the Stores Division.

Material furnished by the Contractor for temporary air vents shall remain the property of the Contractor.

CHAPTER 5.15.0 WATER SERVICES AND BRANCHES

5.15.1 Services — General

All services shall be installed with type "K" soft grade copper furnished by the Contractor. Each service shall be installed with a properly bent gooseneck as shown on Drawing No. 36. All connections to copper pipe shall be made with flared connections except when a copper service is to be installed by boring, and two lengths of piping are required to be connected, the coupling connection shall be silver soldered and tested such that the connection is water tight and at least equal in strength to the uncut piping. All fittings shall be brass comforming to ASTM B62 which, except for corporation stops, shall be furnished by the Contractor unless otherwise noted. The minimum size of service tap and pipe shall be one inch diameter regardless of the size of the existing service. Connections between newly installed services and existing lead services may be made with "Lead-Pak Couplings" as manufactured by the Ford Meter Box Co. Water services and water branches shall be installed in accord with the Water Service Piping Specification except as modified herein.

Taps and "goosenecks" for new services and services installed with 6 feet of cover or greater shall be installed horizontally. Taps and goosenecks with less than 6 feet of cover shall be installed not less than 5 degrees below the horizontal center line of the water main. All services which will have six (6) feet or less cover shall be insulated in accordance with Drawings No. 6 or No. 11 in the "Water Service Piping Specifications."

Copper water services including corporation stops shall be encased in polyethylene film envelope from the water main for a distance of six feet or to the face of the trench wall. Polyethylene material shall be continuous without openings with the polyethylene installed on the pipe.

Prior to the start of construction of a replacement main, the approximate location of the existing corpora-

tion stops will be marked in the field by the City.

Unless otherwise noted, the services shall be pre-tapped dry before the pipe is installed in the following manner:

A. The Contractor shall determine the laying sequence and shall clearly mark the locations at which the taps are required on the pipe. The inspector will view the tap locations.

B. The pipe will normally be tapped by Water Department forces. The Contractor shall, at the proper time, install the corporation stops and if required, service saddles, both furnished by the Water Department, and shall carefully cut and repair polyethylene wrap as required. The Contractor shall be fully responsible for the proper water tight installation.

C. The cost of taps not used and all other work associated with installation at wrong locations, because of Contractor's error shall be at the expense of the Contractor.

When a service is not found at the plan or field marked location, the Contractor shall attempt to locate the service by excavating 6 feet along the water main in each direction from the given location for a total of 12 feet. If the service is found, the service work shall be performed with no additional payment to the Contractor. If the service cannot be found within the limits of the above excavation, the Contractor shall then backfill the excavation. The City will pay the bid unit price of one "C.O.S.", "C.O.S.-short" or "D.S." as described below, whether the service is subsequently found and the work performed or not.

5.15.2 Connect Original Service (C.O.S.)

Where marked "C.O.S.", on plans, the Contractor shall remove the service pipe from the old main and connect the service to the new main. The Contractor shall furnish and install the copper service piping and all fittings required.

All costs shall be included in the unit bid price for Connecting Original Service — C.O.S. The "C.O.S." may be separately listed for bidding as "C.O.S.- short"

and "C.O.S.-long" to reflect the relative length of water service piping required.

5.15.3 Cut-in Curb Stop (C.C.S.)

Where marked "C.C.S." on the plan, the Contractor shall install a new curb stop with the required adapters in the existing 1½ or 2 inch cast iron branch piping. The new curb stop shall be set approximately 3 inches from the property line or 18 inches from the building face in the open street or as noted on the plan. A new curb stop box furnished by the City shall be installed.

The cost of the above materials and work shall be included in the bid price for the "C.C.S." There will be no "Cut-in Curb Stop" bid item where a "C.O.S." or "R.O.S." is to be performed on the same service or branch when the curb stop can be installed within the same or an extended excavation. In this case, the unit bid price for the service work shall include the cut-in curb stop.

5.15.4 Replace Original Service (R.O.S.)

Where marked "R.O.S." on the plan the Contractor shall replace the original service with new copper water service piping of the same size, but not less than 1". If a larger size is shown on the plan, the service shall be extended from the main to the point indicated and connected to the existing service. All cost shall be included in the unit bid price for Replacing Original Service — R.O.S. The "R.O.S." may be separately listed for bidding as "R.O.S.-short" and "R.O.S.-long" to reflect the relative length of water service piping required.

5.15.5 Disconnect Service (D.S.)

Where marked "D.S." on the plans, the Contractor shall disconnect the service at the main as follows:

The corporation stop shall be closed and the copper or lead pipe severed. The Contractor shall then insert a lead disc into the flare nut of the corporation stop and tighten the nut to the corporation stop. Multiple connections within one excavation from the main to one service pipe are to be considered as a single service. The curb stop box shall be removed and abandoned as required in Section 5.14.5.

All costs shall be included in the unit bid price for Disconnect Service-D.S.

5.15.6 Disconnect Branch (D.B.)

Where marked "D.B." on the plans and the branch service pipe is connected to the water main by a tee, the Contractor shall excavate along the branch service a distance of at least 3 feet from the water main and remove the valve box if it lies within the excavation, or the top section only if it is outside the excavation and abandon the remainder. The Contractor shall cut and remove the branch piping, plug the tee, and bulkhead the open end of the branch piping to be abandoned.

If the branch service is connected to a tapping valve and sleeve, the Contractor, in addition to the work described above, except plugging the tee, shall excavate at least 3 feet to each side of the tapping sleeve completely exposing the main and sleeve so they will be ready for inspection. The Contractor shall remove the tapping valve and plug the sleeve if the City determines that it is in good condition.

If the City determines that the water main, or tapping sleeve are in poor condition, the Contractor shall cut, remove and replace that section of main. In addition to the bid item "Disconnect Branch" this work shall be paid for as an extra in accordance with Chapter 2.6.0.

5.15.7 Relocate Curb Stop (R.C.S.)

Where marked "R.C.S." on the plan(s), the Contractor shall install a new curb stop in the existing service piping. The Contractor shall freeze the existing service pipe between the main and the curb stop and cut the existing service piping and install the new curb stop with all required connecting fittings. The curb stop will be furnished by the City. The new curb stop shall be installed as close to the property line as possible with all newly installed pipe and fittings on the street side or at 18 inches from the building face, unless otherwise noted on the plan(s). The new curb stop shall be the same size as the existing water service piping, but not less than 1".

The Contractor shall remove the old service box. The Contractor shall reuse the old box, if in good condition, and set it over the new curb stop. Any part of the old

curb stop box that is not in good condition shall be replaced by the Contractor with new service box material furnished by the City.

The cost of the work and materials shall be included in the unit bid price to Relocate Curb Stop-R.C.S. If there is no bid item, payment will be made in accordance with Chapter 2.6.0.

5.15.8 Roadway Service Box (R.S.B.)

Where required and noted "R.S.B." on plan(s), the Contractor shall install a roadway service box by replacing the top section of the existing standard curb stop box with a top section of a standard valve box and cover furnished by the City. The cost of this work shall be included in the bid price for installing water main unless otherwise noted.

5.15.9 Extension of Service (E.S.)

Services noted as "E.S." on the plan shall be extended to the limits shown on the plan(s). The Contractor shall freeze the existing service piping, remove the curb stop and box and extend the service piping with new copper pipe of the same size, as shown on the plan but not less than one inch. The new copper pipe shall be connected to the existing service pipe and a new curb stop which shall be set 3 inches from the property line or 18 inches from the building face in the open street, unless otherwise noted on the plan. A 12″ stub of service pipe with one end closed in a vice or peened shall be installed in the outlet of the curb stop. The curb stop shall be closed. The old curb stop box, if in good condition, shall be set over the new curb stop. Any part of the old box not in good condition shall be replaced by the Contractor with material furnished by the City.

The cost of the above materials and work shall be included in the unit bid price for the Extension of Service — E.S. If there is no bid item, the payment will be made in accordance with Section 2.6.0.

5.15.10 Temporary Water Service

When deemed necessary by the City, the City will provide temporary water service to consumers. The Contractor shall inform the City 48 hours prior to the time the temporary water service will be required.

5.15.11 Branch Valves

When branch valves are not installed as a tapping valve unit or in conjunction with an "anchoring tee", the Contractor shall furnish and install the necessary joint restraint to tie the valve to the tee.

CHAPTER 5.16.0 BACKFILLING, TRENCH SURFACING, DRAINAGE

5.16.1 Gravel Backfilling

Unless otherwise indicated in the plan(s) or special provisions Gravel Backfill (Type "B") is required for backfill as follows:

A. Paved areas including streets, alleys, walks, parking areas, curbs and gutters, bus stop waiting areas and any other areas with pavement of any type.

B. Road shoulders, gravel roadways and gravel driveways.

C. Any area indicated in the plan(s) or special provisions to be scheduled for pavement construction of any type within the current construction year.

D. Where required by any State or County permit.

Gravel backfill shall be consolidated by flooding as described hereinafter unless another method is specified.

5.16.2 Excavated Material Backfill

When specified in the Contract Documents, the Contractor may use compacted excavated material in lieu of the Type "B" gravel backfill. The backfilling and compaction shall be as hereinafter described.

When this option is exercised and the pavement surface is asphaltic concrete or other flexible pavement, the Contractor shall install an 8" thick crushed stone base surface. The 8" crushed stone base shall consist of 6" of compacted No. 2 stone topped with a vibrated 2" of ¾" graded crushed stone. The cost of this work shall be included in the unit price bid for the water main.

The excavated material backfill shall conform to the requirements of Section 4.6.3 and unless otherwise specified may be used in the following locations.

A. Lawn or garden areas
B. Fields
C. Unpaved boulevard areas
D. Unpaved easement areas

Excavated material used as backfill under this section may be consolidated by compaction or flooding in accordance with section 5.16.10.

Excavated material backfill will not be permitted between December 1, and April 1, without express approval of the Commissioner.

5.16.3 Concrete Backfill or Lightweight Cellular Concrete

Concrete backfill or lightweight cellular concrete shall be used for backfilling the space between the outside of the water main and the inside of a tunnel wall or bore. Lightweight cellular concrete shall be used for backfilling the space between the outside of a water main and the inside of steel casing pipe. Concrete backfill shall also be used to support sewers, and all other utilities crossing trenches, as required in Section 3.5.4.

When cellular concrete is used as backfill for tunnels or borings, the foaming agent shall be introduced into the ready-mix concrete truck at the site. The top portion of each end of the tunnel or bore shall be left open during the pour to permit the visual checking of the progress of the backfilling and to insure complete filling. On tunnels or bores over 30 feet in length, a riser shall be installed at the low end, extending a minimum of 5 feet above the elevation of the high end. The cellular concrete shall be deposited in a riser installed at the high end that extends above the top of the tunnel or bore. The placement of the cellular concrete shall be continuous until it appears and comes up at the low end riser to above the elevation of the high end.

5.16.4 Gravel Encountered in Excavation

When gravel backfill is specified and is encountered in an excavation, the Contractor, upon order of the Commissioner, shall use the excavated gravel for back-

filling the trench. A credit shall then be taken as specified in Section 3.5.23.

5.16.5 Aggregate Slurry Backfill

Where required by the plans, slurry backfill conforming to 4.6.6 shall be installed directly from a transit mix truck. Where limits are shown, the top of slurry backfill shall be at least as far as the limits shown and the repose of the material shall extend beyond.

5.16.6 Placing of Bedding Material Around Pipe

The Contractor shall place bedding around the pipe in such a manner as to insure complete embedment and elimination of voids on all pipe and fittings. If necessary the bedding shall be mechanically compacted by rodding or ramming.

5.16.7 Placing Backfill

All excavations shall be backfilled as soon as practical after the bedding material has been placed.

The backfill shall not be dropped from a height or in a volume so the impact will cause damage to the water pipe or displace the bedding. The Commissioner reserves the right to regulate and control the manner of depositing backfill. Completed backfilling shall not lag more than 300 feet behind the pipe laying. During or when freezing temperatures are anticipated, backfilling shall not lag more than 40 feet behind the pipe laying. Nor shall excavation be ahead of the pipe installation to the extent that the subgrade freezes.

When placing backfill around valve and service boxes, the material shall be placed in such a manner as to prevent displacement or tipping of the boxes. Any movement of the box off the vertical centerline of the valve or stop or tilting of the box from vertical alignment shall be corrected at once.

Excavated material frozen into large masses shall not be used as backfill. This material and material which has frozen in the stockpile shall be replaced with suitable backfill at no additional cost to the City.

5.16.8 Upper Level of Backfill

In graded or paved roadways, the trench shall be backfilled with the specified material to a level such that when the backfill is consolidated, it will be at the proper elevation for the roadway surface as required in Section 5.16.14.

In ungraded streets and in open areas, the trench shall be backfilled with the specified material to the existing surface of the ground or to the proposed or established grade, whichever is lower. The Contractor shall backfill any remaining section of the trench with excavated material.

5.16.9 Minimum Backfill Cover — Ungraded Streets and Open Areas

In areas where the existing surface is less than 5.5 feet above the top of the pipe, the Contractor shall place additional material to provide that cover. The top width of the backfill material shall be equal to the O.D. of the pipe plus 2 feet and the sides sloped 2 horizontal to 1 vertical.

Unless otherwise specified, excavated material meeting the requirements of Section 4.6.3 shall be used, shall be deposited in 6″ maximum layers and compacted mechanically in accordance with 5.16.10.

5.16.10 Consolidation of Backfill

Unless otherwise specified, gravel backfill shall be settled by flooding and excavated material shall be consolidated by mechanical compaction.

(A) Flooding of Gravel Backfill — Gravel backfill shall be settled by flooding the trench with water from the bottom of the trench to the top of the trench. The hoses used for flooding shall be equipped with a regulating valve which permits the hydrant valve to be fully open during use. The hoses shall have a minimum diameter of 1½ inches, a pipe nozzle a minimum diameter of 1½ inches and a minimum length of 4 feet. A longer nozzle shall be used if deemed necessary by the Commissioner. During the flooding operation the nozzle shall be inserted at various angles and

depths into the backfill without damaging the water main, adjacent structures or their foundations, buttresses and anchors or displacing bedding material. The insertions shall be made at intervals of 3 feet or less maintained until the backfill is saturated. Depressions caused by flooding shall be immediately backfilled until there is no further settlement. The Contractor shall provide an adequate supply of water.

(B) Mechanical Compaction of Excavated Material — The trench shall be kept free of visible water during the backfilling and compaction work. The initial lift over ductile iron water main shall be 1 foot. Over other types of water main material, the initial lift shall be 2 feet. Each subsequent lift shall be horizontal and 12 inches in depth. The Contractor shall compact to provide 100 percent of the density of the existing adjacent material in the trench.

(C) Mechanical Compaction of Gravel Material — Where specified, mechanical vibratory compactors shall be used to achieve uniform consolidation of the gravel material. The depth of the initial lift and subsequent horizontal lifts shall be as indicated in (B) above. When gravel aggregate contains sufficient clay fines to form a cohesive soil aggregate, that gravel shall be so compacted so as to result in 100 percent of the density of the existing adjacent material in the trench.

(D) Flooding Excavated Material — Where permitted, the flooding of excavated material shall be completed as indicated in (A) above, for flooding of gravel backfill.

(E) Methods used around valve and stop boxes, manholes, utilities, services and other appurtenances shall be such as to insure compaction and to prevent disturbance and damage.

5.16.11 Existing Grade Below Proposed Water Main

Water mains located in a fill section at an elevation above the existing ground surface, shall be installed as follows:

The topsoil and other organic material shall be removed from the existing surface the entire width of the proposed fill section. An embankment of approved fill material shall be constructed to an elevation of 3 feet above the top of the pipe. The material shall be placed in 6 inch layers and compacted to 100 percent of the density of the fill material.

The width of the top of the fill section shall equal the outside diameter of the pipe plus a minimum of 3 feet on each side of the pipe. The side slopes of fill section shall be not less than 2 feet horizontal to 1 foot vertical. The pipe shall then be installed in a normal manner.

5.16.12 Drainage Requirements

Where placement of the backfill or embankments interferes with natural drainage, the Contractor, when directed by the Commissioner, shall furnish and install a corrugated iron culvert pipe before placing the backfill. If there is no bid price in the contract, payment of this culvert piping shall be in accordance with Chapter 2.6.0.

5.16.13 Backfilling of Tunnel Shafts In Roadways or Other Paved Areas

Work shafts and manhole shafts on tunnels shall be backfilled with Type "B" gravel backfill material and the cost included in the price bid for the water main. Backfilling shall proceed in the same manner as specified for open trench except that first the excavation shall be filled with water to a minimum depth of 2 feet, the gravel being kept inundated throughout the backfill operation. Surfacing requirements are the same as for trenches.

5.16.14 Permanent and Non-Permanent Pavements

Permanent pavements are asphaltic or Portland cement concrete, sheet asphalt, tar macadam or brick. All others shall be considered as non-permanent pavement.

5.16.15 Temporary Surfacing on a Backfilled Trench

The temporary surfacing above trenches required for various existing surfaces shall be as shown below:

TEMPORARY SURFACING REQUIREMENTS

Existing Surface	Temporary Surfacing
1. Alleys, Driveways, and Parking Areas	1 inch of screenings over 6 inches of No. 2 size crushed stone.
2. No Pavement in street on Paving Program	No special reqirement.
3. Roadway Shoulders	8 inches of graded aggregate.
4. Non-Permanent Pavement for a street on the Paving Program	8 inches of graded aggregate and an asphalt palliative placed as required.
5. Non-Permanent Pavement not on Paving Program	(a) Single and double seal coated roadways — 3 inches of bituminous material. (b) Gravel and crushed stone roadways — 8 inches of graded aggregate and an asphaltic dust palliative.
6. Permanent Pavement	3 inches of bituminous material or a 3 inch thick concrete surface.

5.16.16 Backfilling and Surfacing in Alleys, Driveways and Parking Areas

All trench cuts in alleys, driveways, and parking areas shall be backfilled with Type B gravel backfill for the full width or length of the travelled area plus one foot on each side of the travelled area for the full depth of the trench. The shoulders of such backfill shall be sloped away along the length of the trench at the angle of repose of the material. Immediately after backfilling, the travelled area shall be temporarily surfaced with 6 inches of No. 2 size crushed stone topped with one inch of screenings, regardless of the existing type of surface. This temporary surfacing shall be maintained by the Contractor until the permanent surface is placed.

5.16.17 Temporary Surfacing in Roadways

Temporary surfacings in roadways shall conform to the following:

(A) In transverse cuts in arterial roadways, the Contractor shall consolidate backfill by either flooding or mechanical means and immediately thereafter shall place a bituminous surfacing material specified in Chapter 4.7.0. It shall be placed 3 inches thick unless otherwise specified. The subgrade shall be free from standing water and all loose and foreign material. The bituminous material shall be placed outside the area to be surfaced, shoveled immediately into place, raked into a uniformly loose layer of correct depth, and compacted.

(B) On all other trench cuts, when flooding cannot be accomplished immediately, the Contractor shall place temporary surfacing as required in Sec. 5.16.15. This surfacing shall be placed within 72 hours after backfilling.

1. Where graded aggregate is required, it shall be placed to a compacted thickness of 8 inches. A dust palliative meeting the requirements of Section 3.5.19 shall be applied to the graded aggregate and shall be repeated when required.

2. Where bituminous material is required, it shall consist of material as specified in Chapter 4.7.0. It shall be placed 3 inches thick unless otherwise specified, on subgrade that is free from standing water and all loose and foreign materials. Placement shall be as stated in (A) above.

(C) When flooding of the trench has been accomplished, the Contractor shall, within 72 hours after flooding, place the temporary surfacing required in 5.16.15.

1. Where graded aggregate is required, it shall be placed as in (B) 1. above.

2. Where bituminous material is required it shall conform to and be installed in accordance with the requirements of section (A) above. When placed on concrete base, it shall be installed in

accordance with (A) above, except that a 1000 pound roller may be used.

3. Where a concrete shim is required, it shall consist of air-entrained Class A portland cement concrete placed 3 inches thick. A concrete shim may be placed on gravel backfill or on a concrete base which shall be free from standing water and loose and foreign materials. When placed over a concrete base, an approved barrier to prevent bonding shall be placed over the base before the concrete shim is placed. The surface of the concrete shall be given a float finish to provide a surface of uniform texture.

5.16.18 Cost of Backfill and Surfacing

The cost of backfilling shall be included in the unit price bid for water main. Unless otherwise noted, the costs of restoration or replacement of all surfaces including, but not limited to pavements, alleys, sidewalks, carriage walks, curb and gutter sections, lawns, trees and shrubs shall be included in the unit price bid for water main.

The cost of temporary surfacings, other than the concrete shim and bituminous material, shall be included in the price bid for installing the water mains or services, or hydrants. The City will pay for only one bituminous surfacing.

Unless required in the plans, temporary surfacing consisting of concrete shim or bituminous material, when directed to be placed, will be paid for as extras in accordance with the Supplemental Schedule of Fixed prices.

When directed by the Commissioner, temporary surfacing consisting of 3″ thick concrete shim or 3″ thick bituminous surfacing shall be placed and paid for in accordance with the supplemental schedule of fixed prices. Payment shall be limited to the outside diameter of the pipe plus four (4) feet, centered on the pipe.

5.16.19 Maintenance of Trench Surface

The Contractor shall be responsible for placing the specified trench surfacing and for its maintenance and safety to travel for the 2 year guarantee period as speci-

fied in Section 3.5.12 or until the street is paved, whichever occurs first.

In the event that it becomes necessary for City forces to provide emergency maintenance to the Contractor's trenches, the cost of such work will be billed to the Contractor.

5.16.20 Replacement of Lawns, Shrubs, and Trees

The replacement of lawns, shrubs and trees shall be done by the Contractor as follows:

(A) Where water mains are constructed in a street with permanent pavement, curb, gutter and/or sidewalk, the Contractor shall replace all lawns disturbed in the process of water main construction. This lawn replacement shall be Type A unless otherwise directed by the Commissioner.

(B) Where water mains are constructed in an established lawn area in a street which has not been graded to its final width and the street is not on the current year's paving program, the Contractor shall replace all lawns with Type B lawn replacement.

(C) Where water mains are constructed in areas where vegetation or field grass exists and in State and County highways, the Contractor shall assure growth with Type C grass treatments.

The following shall be standard types of lawn and grass treatments:

1. Type A — Replace lawn with top graded nursery sod conforming to the requirements of Section 4.4.18 and installed upon and a sod bed brought to the proposed subgrade, scarified and raked to loosen the soil. All stones, roots and other foreign material shall be removed.

   A commerical fertilizer shall be spread over the area, using the rate of 2 pounds per 100 square feet of 10-10-10 fertilizer.

   All sod strips shall be laid snugly against the previously laid strips. Sod shall be laid so that the joints caused by abutting ends of sod strips are not

continuous. The sod shall be lightly tamped or rolled.

All sodded areas shall be maintained by the Contractor until they are accepted by the City. The Contractor shall be responsible for all watering required to establish the sodded areas. The Contractor shall replace such sod as may be required to obtain even growth. The sodding will not be accepted until the City is assured of established growth.

2. Type B — Replace lawn by fine grading the construction area, evenly spreading 3 inches of screened top soil, fertilizing the top soil in accordance with the seed manufacturer's recommendations, seeding the area at the rate of 4 pounds per 1000 square feet, raking or dragging the area to cover the seed, and covering the area with a layer of properly secured mulch. The grass seed mixture shall conform to the requirements of Section 4.4.17.

3. Type C — Scarify the surface area, fertilize the surface in accordance with the seed manufacturer's recommendations, seed the area at the rate of 3 pounds per 1000 square feet of area, rake or drag the area to cover the seed; and cover the area with a layer of properly secured mulch. The seed mixtures shall contain 50 percent Alta Fescue, 30 percent Kentucky Blue Grass, and 20 percent Perennial Rye Grass.

The cost of such lawn and grass treatments shall be included in the price bid for the water main. When an existing lawn area is damaged by a Contractor and not repaired by that Contractor, the City will take a credit for the cost of repairing such damage in accordance with the prices listed in the Supplemental Schedule of Fixed Prices. The type of lawn will be determined by the Commissioner.

Any of the above lawn and grass treatments may be ordered as an extra when it is deemed necessary to establish a lawn or grass in any area within the contract limits. When so ordered, payment will be made in accordance with the prices listed in the Supplemental Schedule of Fixed Prices.

The Contractor shall take adequate measures to assure growth of all types of lawn and grass treatments.

The Contractor shall replace all trees and shrubs which are damaged in construction to substantially their original condition just prior to commencement of the work. These replacements shall be approved by the Commissioner and made at no cost to the City.

CHAPTER 5.17.0 HYDROSTATIC PRESSURE AND LEAKAGE TESTS

5.17.1 Tests Required

Unless otherwise determined, City forces will make hydrostatic pressure and leakage tests of all new mains having a continuous installed length in excess of 120'. All mains tested must successfully pass these tests before they will be accepted.

The duration of the final leakage tests shall normally be one hour.

5.17.2 Preparation for Testing Mains

Preparation for testing water mains shall consist of the following:

(A) In order to facilitate testing of new mains, the Contractor shall isolate the main to be tested by temporarily plugging or capping both ends of the mains along with adequate strapping or blocking. In long installations, the Commissioner may order portions of the installation to be tested separately.

(B) The Contractor shall supply the necessary fittings required to make the connections for the test.

(C) The Contractor shall provide and maintain tight-sheathed excavations around the ends of the main.

(D) The Contractor shall return to the site and make the permanent connections after the completion of successful tests and/or chlorination or safe

water sample. The cost of all work in this section shall be included in the bid price for the water main.

5.17.3 Hydrostatic Pressure and Leakage Tests

The hydrostatic pressure and leakage tests may be run simultaneously.

(A) Pressure Test — After the main has been filled and all air expelled, the pressure shall slowly be raised to 150 psi at the lowest elevation of the water main.

Any defects or leaks in the main disclosed by the test shall immediately be repaired by the contractor. The City will repeat the test until all defects or leaks have been corrected.

(B) Leakage Test — After the main has been tested at 150 psi, it shall be subjected to a leakage test at the same pressure.

Allowable leakage is defined as the quantity of water supplied into the main necessary to maintain the specified 150 psi pressure.

Allowable leakage shall not exceed the number of gallons per hour (GPH) as determined by the following formula for rubber gasketed joints:

$$GPH = \frac{ND\sqrt{P}}{3700}$$

N = Number of joints under test
D = Nominal diameter of main in inches
P = Average pressure in pounds per square inch gauge during the test.

When pipe with lead joints is tested, the allowable leakage computed by the above formula shall be doubled.

If various diameters and/or different type joints are included in the main being tested, the allowable leakage shall be the sum of the calculations for each size and type of joint.

5.17.4 Cost of Tests

The City will assume the cost of a total of two tests on

any section of main installed. A combination test for pressure and leakage will be considered as one test. The City will also assume the cost of one drainage and refilling of any section of main installed. Additional tests, including any further draining and refilling of the main, will be made at the Contractor's expense.

5.17.5 Delays Due to Tests

The Contractor will not be compensated for extra costs due to delays for hydrostatic testing.

5.17.6 Pre-Testing

The Contractor, with the permission of the Commissioner, may fill sections of new main and run hydrostatic pressure and leakage tests prior to the City tests. These tests will be at the Contractor's risk and expense and at no cost to the City. The tests will be for the Contractor's convenience and will not be considered the official acceptance test by the City.

CHAPTER 5.18.0 SAFE DRINKING WATER PROCEDURES AND TESTS

5.18.1 Bacterial Test

Water from all new mains must successfully pass bacterial tests performed by the City before the main is accepted for use.

5.18.2 Flushing Distribution Mains

Shortly after the installation of the main is completed, Water Distribution Division crews will operate the necessary valves admitting water to the new mains. Contractors are NOT to operate valves under any circumstances. The Contractor, upon notification to proceed with flushing the main, shall attach a valve to the nozzle of a hydrant or air-vent as required by the Commissioner. The Contractor shall attach a 1½" hose to the outlet of the valve to direct the flow of water to a point of safe and adequate drainage such as storm sewers or surface drainage. The main shall then be flushed by the contractor by fully opening the hydrant, or air vent, and throttling the installed valve to control the flow.

This procedure shall be repeated on all segments of newly installed mains until water samples obtained have successfully passed the bacterial tests for safe water sample.

The City will provide the water for flushing free of charge.

The Contractor will be held responsible for any damage caused by the flushing operation.

5.18.3 Chlorinating Distribution Mains

When indicated on the plans or when, because of unsatisfactory results by flushing alone, the Commissioner has issued orders to disinfect the main by chlorination, the Contractor shall provide a tight-sheathed excavation around the main at the point of chlorination as directed at no cost to the City. After the excavation is prepared, the City will tap the main and connect and operate a chlorinator without cost to the Contractor.

When a satisfactory chlorine residual has been obtained, the Contractor, after a minimum of 24 hours and a maximum of 72 hours, shall proceed with the flushing of the main as specified in Section 5.18.2

5.18.4 Cleaning and Disinfecting Feeder Main Interiors

The Contractor shall keep the main clean as work progresses. After completion he shall again thoroughly clean the feeder main of dirt, construction debris, or other foreign material prior to the initial filling of the main by Water Distribution Division crews. If the main has been subjected to contamination by sewage, ground water, or surface water, he shall swab or spray the portion of the main so contaminated with an acceptable disinfectant solution after it has been cleared of all foreign matter.

5.18.5 Chlorination of Feeder Mains

The City will chlorinate all mains 20″ in diameter and larger. The Contractor shall have men and equipment available as required to pump out manholes and to uncover and clean out valve boxes on the new line. Contractor shall provide the work area for chlorination as required in Section 5.18.3.

5.18.6 Flushing of Feeder Mains

Water Distribution Division crews shall flush all mains 20″ in diameter and larger. The Contractor shall furnish and place flushing hoses as directed by the Commissioner in accordance with Section 5.18.2.

5.18.7 Petcock for Obtaining Samples

The Contractor shall provide a petcock in the flushing line whether from a hydrant or an air-vent, and any other accessories required for taking of water samples. The petcock shall be placed in an easily accessible location with the nozzle facing downward. It shall be free from any possible ground water contamination.

5.18.8 Time Spent Flushing Water Mains

Unless other work is taking place concurrently, the time on the contract shall normally not continue to run during the period needed to obtain safe water samples. However, time on the contract shall resume running if the contractor has not, within two days of issuance, complied with the directives of the Commissioner for commencing and maintaining flushing. The time shall continue to run until such directives are complied with.

5.18.9 Calcium Hypochlorite Treatment

When water mains are installed in trenches where there is a possibility of contamination, the City will furnish and the Contractor shall apply a quantity of calcium hypochlorite of lime as determined by the Commissioner. It shall be applied to the open ends of the pipes as they are being installed. They will then be flushed as specified in Section 5.18.2.

5.18.10 Delays due to Chlorinating and Flushing Mains

The Contractor will not be compensated for extra costs due to delays necessitated by chlorinating, flushing, sampling, or testing.

CHAPTER 5.19.0 REPLACEMENT OF PAVEMENT, SIDEWALK, DRIVEWAY, ALLEY, CURB AND GUTTER

5.19.1 Method of Payment

Unless otherwise noted, the cost of restoration or replacement of all surface features damaged or destroyed by the Contractor during the execution of the contract shall be included in the unit price bid for the water mains. The surface features shall include but not be limited to pavements, alleys, sidewalks, carriage walks, curb and gutter sections, lawn and shrubs. The cost of temporary surfacing and maintenance shall also be included in the bid price except as stated in 5.16.18.

Because of variable conditions, such as weather and the Contractor's progress, more than one type of pavement replacement or temporary surfacing may be necessary. The Contractor may be directed to place one or more of these pavement types, in whole or in part.

The provisions of this section do not affect the placing of temporary surfacing required in Section 5.16.15.

5.19.2 Replacement of Pavement, Alleys, Sidewalks, Curb and Gutter and Driveway

The work shall be done as follows:

(A) The backfill material in the water main trench shall be consolidated in accordance with Chapter 5.16.10. The trench, if flooded, shall be allowed to settle for 3 days or for a period of time that the Commissioner shall deem necessary before the work may start on the pavement replacement.

(B) All pavement cuts shall be parallel or perpendicular to the curb alignment. Where the curb is within 5 feet and parallel to the new main or the side of the trench is within 2 feet of a pavement joint, only the side of the trench away from the curb or joint shall be cut. Pavement shall be removed and replaced to the flange of the gutter and/or pavement joint. Whenever the pavement replacement will not abut against a pavement

joint, the adjoining pavement shall be sawed to depth of 3 inches or be trimmed clean of any shattered or split material.

The subgrade shall be prepared and the following pavement placed in accordance with the City of Milwaukee Street Construction Specifications.

1. Concrete pavement and concrete base pavement shall consist of one course air-entrained Class A Portland Cement Concrete. The thickness shall equal the original pavement, with a minimum of 8 inches.

2. Concrete alleys and concrete driveways shall consist of a one course air-entrained Class A Portland Cement Concrete. The thickness shall equal the original pavement, with a minimum of 7 inches.

3. Concrete walks shall be constructed of one course air-entrained Class C Portland Cement Concrete. The walk shall be 5 inches thick.

4. Curb and gutter shall be constructed of air-entrained Class A Portland Cement Concrete. Unless otherwise specified, the cross-section of the curb and gutter shall conform to the adjacent curb and gutter section.

5. Handicap pedestrian ramps shall be required when specified in the Contract Documents. The Contractor shall replace that section of curb and adjacent walk to include a handicap ramp.

6. Asphaltic concrete and macadam pavement replacement shall consist of a 2 course pavement 3 inches thick, unless otherwise specified. The base course shall be 2 inches of asphalt binder. The surface course shall be 1 inch of ¼ inch maximum size coarse aggregate asphaltic concrete. The base course shall be placed on a nine (9) inch crushed stone base consisting of seven (7) inches of No. 2 crushed stone topped with two (2) inches of ¾ inch graded crushed stone.

CHAPTER 5.20.0 REPAIR OF WATER MAIN BREAKS DURING CONSTRUCTION

5.20.1 Method of Payment

The Contractor shall repair all mains breaks on the old main which occur during normal working hours on water main replacement or water main abandonment projects. The Milwaukee Water Works will operate the valves for the shut-off. Contractor shall be responsible for furnishing repair clamps or other repair material, and shall do all work required to complete the repair and restore service. Since the Contractor's repair clamps are temporary, they need not conform to the W.E.D. specification when installed on pipe to be abandoned or replaced.

The Contractor will be paid an extra for each main break repair in accordance with the Supplemental Schedule of Fixed Prices.

Water services or branches damaged as a result of the construction work shall be repaired by the Contractor at his own cost.

All other water main breaks will be repaired by the Milwaukee Water Works.

PART 6
SPECIFICATION DRAWINGS
INDEX OF DRAWINGS

NOMINAL PIPE DIAMETER	DUCTILE IRON PUSH-ON OR MECH. JOINT					P.V.C. PUSH-ON			CONCRETE PUSH-ON			
	MAX. DEFL (°-')	MAX. DEFL. INCHES		MIN. RADIUS FEET		MAX. DEFL INCHES	MIN. RAD. FEET		MAX. DEFL (°-')	MAX. DEFL INCHES	MIN. RAD. FEET	
		18 FT.	20 FT.	18 FT.	20 FT.	20 FT.	20 FT.			20 FT.	20 FT.	
4"	5-00	19	21	205	230	21	230					
6"	5-00	19	21	205	230	21	230					
8"	5-00	19	21	205	230	16	300					
12"	5-00	19	21	205	230	12	380					
16"	3-00	11	12	340	380				2-19	9¾	494	
20"	3-00	11	12	340	380				1-52	7¾	614	
24"	2-00	7½	8	510	570				1-34	6⅞	734	
30"	2-00	7½	8	510	570				1-15	5¼	914	
36"	2-00	7½	8	510	570				1-03	4¼	1094	
42"	2-00	7½	8	510	570				1-04	4¼	1082	
48"	2-00	7½	8	510	570				1-07	4½	1027	
54"	1-30	5½	6	680	760				1-07	4½	1027	
60"									1-07	4½	1027	

DEFLECTION IN INCHES IS THE OFFSET FROM THE LINE OF THE ADJACENT PIPE AS MEASURED AT THE EXTREME END OF THE LENGTH.

L - PIPE LENGTH IN FEET

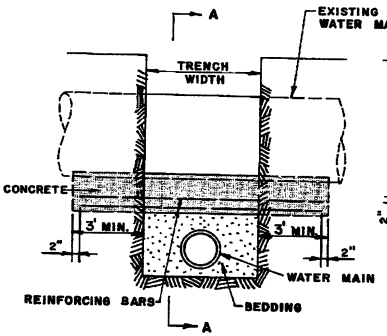
θ - DEFLECTION IN DEGREES & MINUTES

D - DEFLECTION IN INCHES

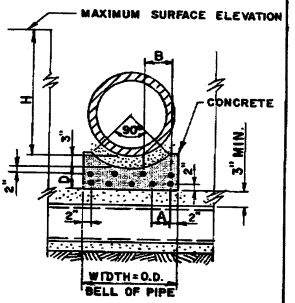
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

PERMISSABLE JOINT & PIPE DEFLECTION

DESIGNED BY E. Kaliss DRAWN BY J.A.S.
CHECKED BY W.C. Bauhs DATE 12-16-85
APPROVED [signature]
APPROVED [signature] DRWG. NO. 1



ELEVATION



SECTION A-A

BEAM DIMENSIONS

TRENCH WIDTH FEET	DEPTH (H) - FEET														
	0-4.9			5-6.9			7-8.9			9-11.9			12-15		
	A	B	D	A	B	D	A	B	D	A	B	D	A	B	D
2-2.4	6"	-	6"	6"	-	6"	6"	-	6"	6"	-	6"	6"	-	6"
2.5-3.4	6"	-	6"	6"	-	6"	6"	-	6"	6"	-	7"	6"	-	7"
3.5-4.4	6"	-	7"	6"	-	7"	6"	-	7"	6"	-	8"	6"	-	9"
4.5-5.9	6"	-	8"	5"	-	8"	5"	-	8"	4"	-	9"	4"	-	10"
6.0-6.9	4"	6"	9"	4"	6"	9"	4"	6"	9"	3"	5"	10"	4"	6"	12"
7.0-8.0	4"	6"	10"	3"	5"	10"	3"	5"	10"	3"	5"	12"	3"	4"	13"
8.1-10	4"	5"	12"	3"	4"	12"	3"	4"	12"	3"	4"	14"	3"	4"	16"

NOTES

1. CONCRETE TO BE CLASS "A"
2. REINFORCING BARS TO BE NO. 5
3. FOR TRENCH WIDTH OVER 10 FEET OR TRENCH DEPTH OVER 15 FEET. BEAM SHALL BE INDIVIDUALLY DESIGNED OR AS INDICATED ON THE PLAN.
4. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON NOT SHOWN.

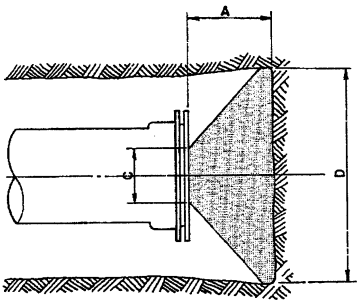
LEGEND:

A = SPACING, LOWER STEEL
B = SPACING, UPPER STEEL
D = MINIMUM DEPTH OF BEAM

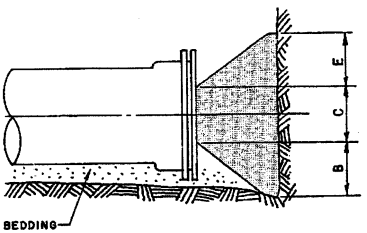
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

REINFORCED BEAM FOR SUPPORT OF PIPELINE OR WATER MAIN

DESIGNED BY E.K. DRAWN BY D.L.P. JAS
CHECKED BY W.G. DATE 2-3-86
APPROVED R.P.K.
APPROVED DRWG. NO. 2



PLAN



ELEVATION

NOTES

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND A SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
2. CONCRETE TO BE CLASS "F"
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND
4. BUTTRESS TO BE SHAPED TO ACCOMMODATE AIR VENT OR DRAIN WHEN NECESSARY
5. POLYETHYLENE FILM ENVELOPE NOT SHOWN.

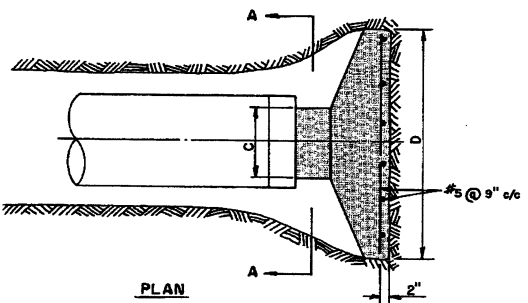
BUTTRESS DIMENSIONS					
SIZE	A	B	C	D	E
4"	6"	6"	3"	1'-0"	8"
6"	8"	6"	3"	1'-8"	10"
8"	1'-0"	9"	5"	2'-0"	1'-0"
12"	1'-3"	10"	8"	2'-6"	1'-4"
16"	1'-9"	1'-0"	1'-0"	4'-0"	2'-0"

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

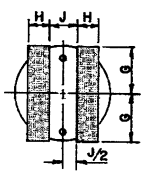
BUTTRESSES FOR CAP OR PLUG
4" THROUGH 16"

DESIGNED BY E. Kaley DRAWN BY J.A.S.
CHECKED BY W.C. Pratt DATE 1-8-86
APPROVED
APPROVED DRWG. NO. 3

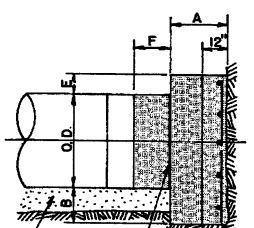
PIPE SIZE	BUTTRESS DIMENSIONS					BLOCKING DIMENSIONS			
	A	B	C	D	E	F	G	H	J
20"	1'-6"	1'-6"	1'-6"	5'-0"	6"	8"	1'-0"	6"	6"
24"	1'-6"	1'-9"	1'-10"	5'-3"	9"	8"	1'-3"	7"	6"
30"	2'-0"	2'-0"	2'-0"	6'-0"	1'-3"	1'-6"	1'-6"	9"	6"
36"	2'-0"	2'-0"	2'-6"	8'-0"	1'-3"	1'-6"	1'-9"	1'-0"	6"
42"	2'-6"	2'-0"	2'-6"	9'-9"	1'-3"	1'-6	2'-3"	1'-0"	6"
48"	2'-6"	2'-0"	3'-0"	10'-6"	1'-3"	1'-6"	2'-6"	1'-0"	1'-0"
54"	3'-6"	2'-0"	3'-6"	12'-3"	1'-3"	1'-6"	2'-9"	1'-3"	1'-0"
60"	3'-6"	2'-0"	4'-0"	14'-0"	1'-3"	1'-6"	3'-0"	1'-6"	1'-0"



PLAN



SECTION A-A
ALTERNATE BLOCKING
DETAIL WHERE VENT AND
DRAIN ARE REQUIRED



ELEVATION

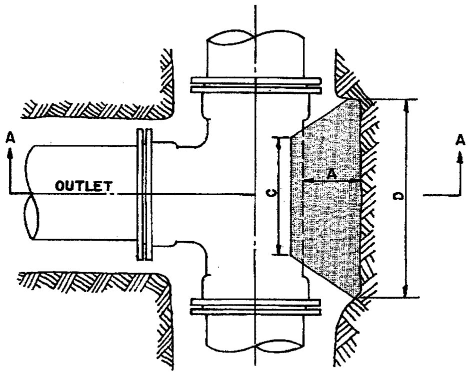
NOTES

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND ON SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
2. CONCRETE TO BE CLASS "F"
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND
4. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON PIPE NOT SHOWN.

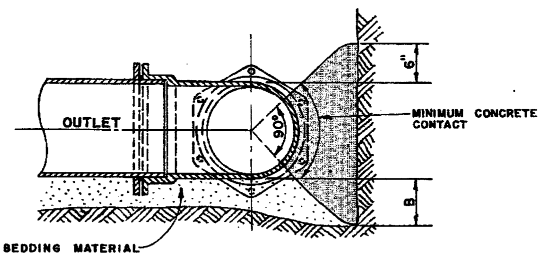
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

BUTTRESSES FOR CAP OR PLUG
20" THROUGH 60"

DESIGNED BY E. Kalina DRAWN BY J.A.S.
CHECKED BY W.C. Evans DATE 1-10-86
APPROVED
APPROVED DRWG. NO. 4



PLAN



SECTION A-A

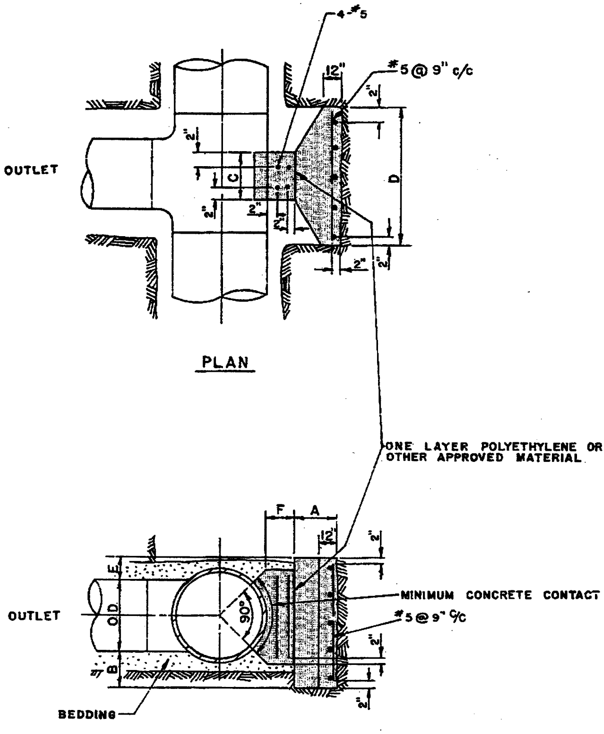
1. PROVIDE CLEARANCE ON CONCRETE ADEQUATE FOR REMOVING MECHANICAL JOINT BOLTS
2. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND A SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
3. CONCRETE TO BE CLASS "F"
4. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND
5. POLYETHYLENE FILM ENVELOPE NOT SHOWN.

BUTTRESS DIMENSIONS				
OUTLET SIZE	A	B	C	D
4"	6"	6"	6"	9"
6"	6"	6"	10"	1'-4"
8"	8"	8"	1'-0"	1'-6"
12"	10"	10"	1'-4"	2'-3"
16"	1'-0"	1'-0"	2'-0"	3'-6"

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

BUTTRESSES FOR TEES
4" THROUGH 16" OUTLETS

DESIGNED BY ____ DRAWN BY J.A.S
CHECKED BY ____ DATE 12-27-85
APPROVED ____
APPROVED ____ DRWG. NO. 5



PLAN

ELEVATION

NOTES

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND A SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
2. CONCRETE TO BE CLASS "F"
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND
4. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON NOT SHOWN.

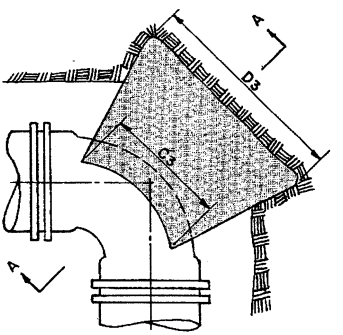
OUTLET SIZE	BUTTRESS DIMENSIONS					
	A	B	C	D	E	F
20"	1'-6"	1'-6"	1'-6"	5'-0"	6"	8"
24"	1'-6"	1'-9"	1'-8"	5'-3"	9"	1'-6"
30"	2'-0"	2'-0"	2'-0"	6'-0"	1'-3"	1'-6"
36"	2'-0"	2'-0"	2'-6"	8'-0"	1'-3"	1'-6"
42"	2'-6"	2'-0"	2'-6"	9'-9"	1'-3"	1'-6"
48"	2'-6"	2'-0"	3'-0"	10'-6"	1'-3"	1'-6"
54"	3'-6"	2'-0"	3'-6"	12'-3"	1'-3"	1'-6"
60"	3'-6"	2'-0"	4'-0"	14'-0"	1'-3"	1'-6"

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

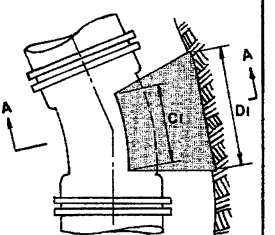
BUTTRESSES FOR TEES
20" THROUGH 60" OUTLET

DESIGNED BY [illegible] DRAWN BY J.A.S.
CHECKED BY [illegible] DATE 1-3-86
APPROVED [illegible]
APPROVED [illegible] DRWG. NO. 6

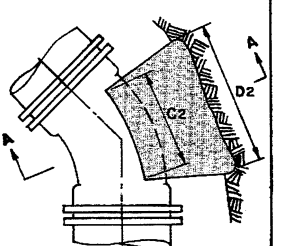
PIPE SIZE	BUTTRESS & BASE DIMENSIONS								
	A	B	22½° BEND		45° BEND		90° BEND		E
			C1	D1	C2	D2	C3	D3	
4"	9"	4"	5"	8"	5"	10"	5"	1'-4"	1'-3"
6"	1'-0"	6"	6"	9"	6"	1'-4"	6"	1'-9"	1'-6"
8"	1'-2"	8"	8"	10"	8"	1'-6"	8"	2'-6"	2'-0"
12"	1'-6"	10"	9"	1'-0"	9"	2'-0"	1'-0"	3'-3"	2'-6"
16"	2'-0"	1'-0"	10"	1'-6"	10"	2'-9"	1'-4"	4'-10"	3'-0"
20"	2'-6"	1'-4"	1'-0"	2'-0"	1'-0"	3-9"	1'-8"	6'-6"	3'-9"
24"	3'-0"	1'-6"	1'-0"	2'-3"	1'-0"	4'-6"	2'-0"	8'-0"	4'-3"



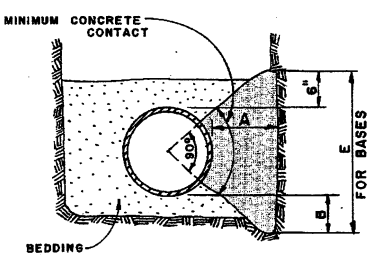
PLAN-90° BEND



PLAN-22½° BEND



PLAN-45° BEND



SECTION A-A

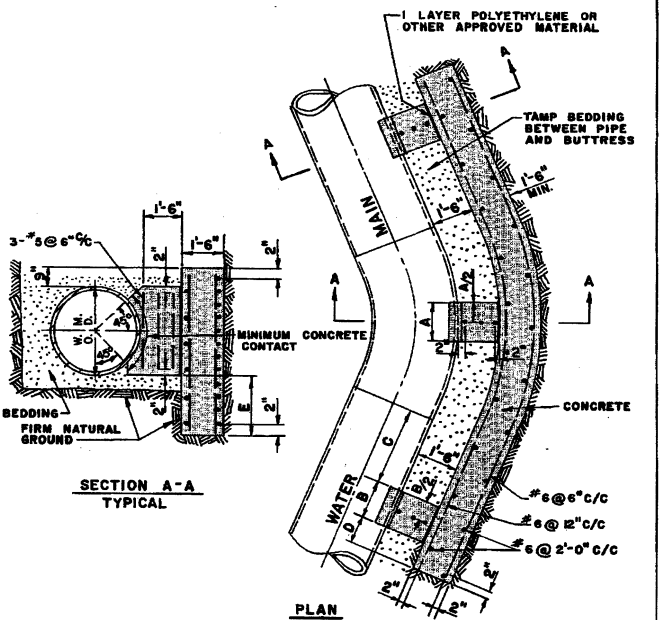
NOTES

1. PROVIDE CLEARANCE ON CONCRETE ADEQUATE FOR REMOVING MECHANICAL JOINT BOLTS.
2. POLYETHYLENE FILM ENVELOPE NOT SHOWN
3. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND A SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
4. CONCRETE TO BE CLASS "F"
5. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS.
MILWAUKEE, WISCONSIN

BUTTRESSES AND BASES FOR 4" THROUGH 24" BENDS

DESIGNED BY E. Kalin DRAWN BY DLP, JAS
CHECKED BY [illegible] DATE 12-19-85
APPROVED [illegible]
APPROVED [illegible] DRWG. NO. 7



PIPE SIZE	BUTTRESS DIMENSIONS									
	6°-11¼° BENDS					11½°-22½° BENDS				
	A	B	C	D	E	A	B	C	D	E
30"	9"	9"	6"	6"	1'-0"	1'-0"	9"	6"	6"	1'-0"
36"	9"	9"	6"	6"	1'-0"	1'-0"	9"	9"	9"	1'-0"
42"	9"	9"	6"	6"	1'-0"	1'-0"	1'-0"	1'-0"	9"	1'-0"
48"	9"	9"	6"	6"	1'-3"	1'-0"	1'-0"	1'-0"	1'-0"	1'-3"
54"	9"	9"	9"	6"	1'-3"	1'-3"	1'-3"	1'-0"	1'-0"	1'-6"
60"	1'-0"	1'-0"	9"	6"	1'-6"	1'-6"	1'-6"	1'-0"	1'-0"	1'-9"

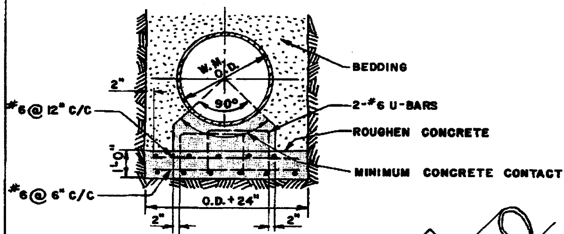
NOTES

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND ON SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
2. CONCRETE TO BE CLASS "F"
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND.
4. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON PIPE NOT SHOWN.
5. BUTTRESS FOR BEND GREATER THAN 22½° SHALL BE INDIVIDUALLY DESIGNED OR AS INDICATED ON THE PLAN.

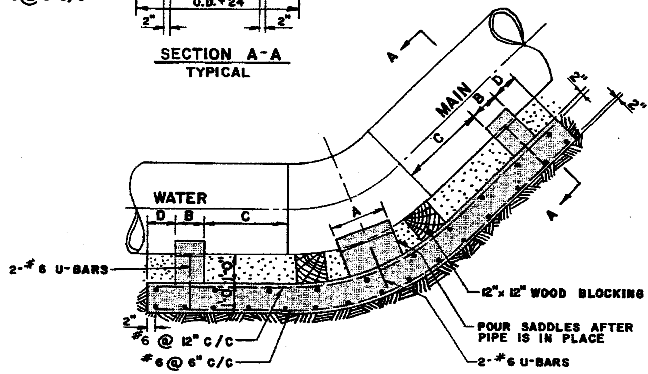
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

BUTTRESS FOR 30" THRU 60" HORIZONTAL BENDS

DESIGNED BY E. Kalina DRAWN BY D.L.P./JAS
CHECKED BY W. Gavey DATE 2-6-86
APPROVED
APPROVED DRWG. NO. 8



SECTION A-A
TYPICAL



ELEVATION

PIPE SIZE	BASE DIMENSIONS							
	6°-11¼° BENDS				11½°-22½ BENDS			
	A	B	C	D	A	B	C	D
30"	9"	9"	6"	6"	1'-0"	9"	6"	6"
36"	9"	9"	6"	6"	1'-0"	9"	9"	9"
42"	9"	9"	9"	6"	1'-0"	1'-0"	1'-0"	9"
48"	9"	9"	9"	6"	1'-0"	1'-0"	1'-3"	1'-0"
54"	9"	9"	1'-0"	6"	1'-3"	1'-3"	1'-6"	1'-0"
60"	1'-0"	1'-0"	1'-3"	6"	1'-6"	1'-6"	1'-9"	1'-0"

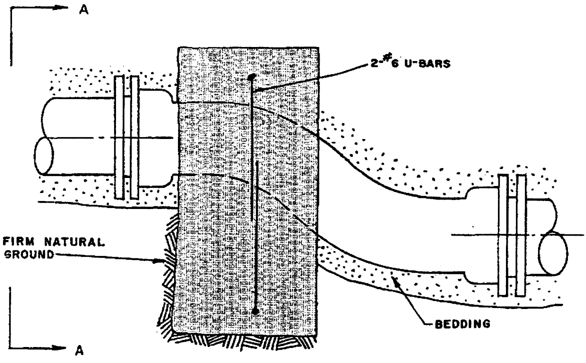
NOTES

1. DIMENSIONS IN TABLE ARE BASED ON A WATER PRESSURE OF 150 PSI AND ON SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
2. CONCRETE TO BE CLASS "F"
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND.
4. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON PIPE NOT SHOWN.
5. BASE FOR BEND GREATER THAN 22½° SHALL BE INDIVIDUALLY DESIGNED OR AS INDICATED ON THE PLAN.

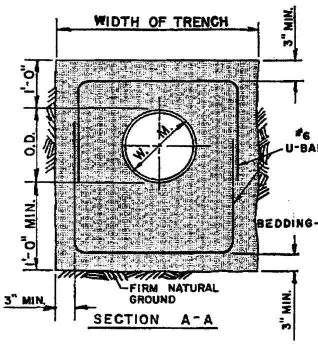
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

BASE FOR VERTICAL BENDS
30" THRU 60"

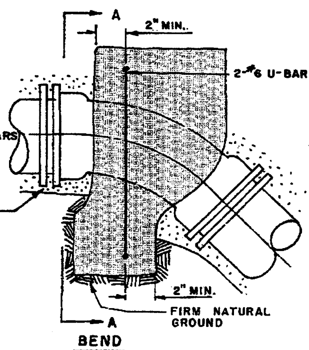
DESIGNED BY E. Kalis DRAWN BY DLP, JAS
CHECKED BY Walter [illegible] DATE 2-12-86
APPROVED [illegible]
APPROVED [illegible] DRWG NO. 9



OFFSET



SECTION A-A



BEND

NOTES

1. CONCRETE VOLUMES ARE BASED ON WATER PRESSURE OF 150 PSI WITH BACKFILL OR 100 PSI WITHOUT BACKFILL
2. ALL CONCRETE TO BE CLASS "F"
3. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
4. PROVIDE CLEARANCE ON CONCRETE ADEQUATE FOR REMOVING MECHANICAL JOINT BOLTS
5. ANCHOR SIMILAR TO TYPE SHOWN IN DRW'G. NO. 11 MAY ALSO BE USED FOR 6" & 8" BENDS.

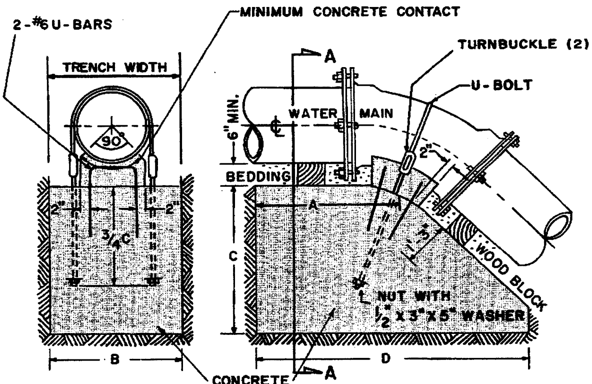
ANCHOR - VOLUME OF CONCRETE - CU. YD.

PIPE SIZE	OFFSET				BEND		
	6"	12"	18"	24"	45°	22 1/2°	11 1/4°
4"	0.2	0.4	0.4	NA	0.4	0.2	0.1
6"	0.4	0.6	0.7	1.7	0.9	0.4	0.2
8"	0.7	1.1	1.2	2.0	1.6	0.7	0.4
12"	1.2	1.6	1.7	2.5	SEE DWG. NO. 11		
16"	2.1	2.[illegible]	3.1	NA			

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

ANCHOR BLOCK
OFFSETS 4"-16" BENDS 4"-8"

DESIGNED BY [illegible] DRAWN BY DLP, JAS
CHECKED BY [illegible] DATE 1-16-86
APPROVED [illegible]
APPROVED [illegible] DRW'G NO. 10



SEC. A-A

ELEVATION

PIPE SIZE	ANCHOR DIMENSIONS BEND	A	B	C	D	CU.YD. CONC.	BOLT DIA.
12"	11¼°	2'-0"	3'-1"	2'-3"	3'-6"	0.7	¾"
	22½°	3'-0"	3'-1"	3'-0"	5'-3"	1.4	1"
	45°	4'-0"	3'-1'	4'-3"	6'-9"	2.6	1"
16"	11¼°	2'-8"	3'-5"	2'-6"	5'-0"	1.2	1"
	22½°	3'-9"	3'-5"	3'-6"	6'-9"	2.3	1"
	45°	5'-6"	3'-5"	5'-0"	8'-9"	4.5	1⅛"

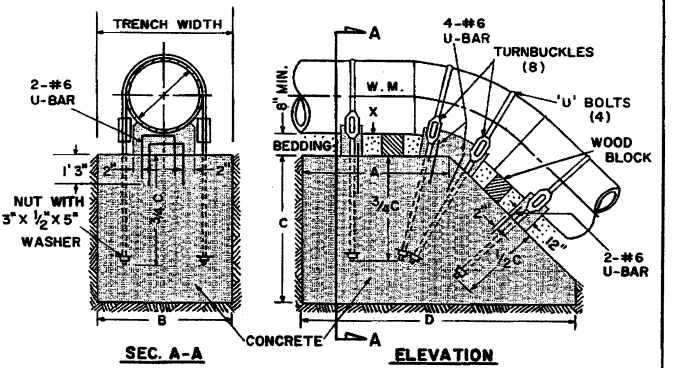
NOTES:

1. DESIGN IS BASED ON WATER PRESSURE OF 150 PSI WITH BACKFILL OR 100 PSI WITHOUT BACKFILL.
2. ALL CONCRETE TO BE CLASS "F".
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND.
4. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
5. AFTER ASSEMBLY ALL FERROUS MATERIALS OUTSIDE OF THE POLYETHYLENE ENVELOPE SHALL BE TOTALLY ENCAPSULATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822.
6. ANCHOR FOR BEND GREATER THAN 45° SHALL BE INDIVIDUALLY DESIGNED AS INDICATED ON THE PLAN.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

ANCHOR FOR 12" & 16" BENDS

DESIGNED BY E. Kaley DRAWN BY M.A.D.L.P
CHECKED BY W. Powers DATE 4-8-1986
APPROVED R. J. Kozol
APPROVED J. Jangure DRWG. NO. 11



BEND	PIPE SIZE	ANCHOR DIMENSIONS A	B	C	D	X	CONC. CU.YD.	BOLT DIA.
5½° TO 11¼°	20"	3'-0"	4'-0"	3'-0"	5'-0"	1'-0"	2	1"
	24"	3'-3"	4'-6"	3'-3"	6'-0"	1'-0"	3	1"
	30"	4'-0"	5'-0"	4'-0"	7'-0"	1'-6"	4	1"
	36"	4'-6"	6'-0"	4'-6"	7'-6"	1'-6"	5	1"
	42"	4'-9"	7'-0"	4'-9"	8'-0"	1'-6"	7	1¼"
	48"	5'-0"	8'-0"	5'-0"	8'-6"	1'-6"	8	1¼"
	54"	5'-0"	9'-0"	5'-0"	9'-0"	1'-6"	10	1¼"
	60"	5'-3"	10'-0"	5'-3"	9'-3"	1'-6"	12	1½"
11½° TO 22½°	20"	4'-0"	4'-0"	4'-6"	7'-0"	1'-0"	4	1"
	24"	4'-3"	4'-6"	4'-6"	7'-6"	1'-0"	5	1"
	30"	5'-9"	5'-0"	5'-9"	9'-0"	1'-6"	8	1¼"
	36"	6'-0"	6'-0"	6'-0"	10'-0"	1'-6"	11	1¼"
	42"	6'-3"	7'-0"	6'-3"	10'-6"	1'-6"	14	1½"
	48"	6'-6"	8'-0"	6'-6"	11'-0"	1'-6"	16	1¾"
	54"	6'-9"	9'-0"	6'-9"	11'-6"	1'-6"	20	2"
	60"	7'-0"	10'-0"	7'-0"	12'-0"	1'-6"	24	2"

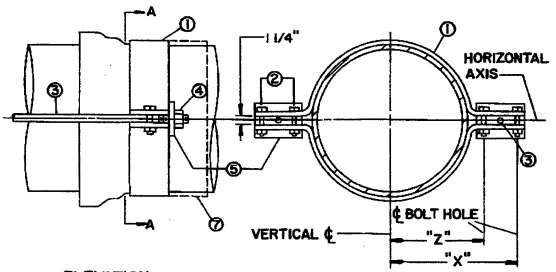
NOTES:

1. DESIGN IS BASED ON WATER PRESSURE OF 150 PSI WITH BACKFILL OR 100 PSI WITHOUT BACKFILL.
2. ALL CONCRETE TO BE CLASS 'F'
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND.
4. ANCHOR FOR VERTICAL BENDS GREATER THAN 22½° SHALL BE INDIVIDUALLY DESIGNED OR AS INDICATED ON THE PLAN.
5. AFTER ASSEMBLY, ALL FERROUS MATERIALS OUTSIDE OF THE POLYETHYLENE ENVELOPE SHALL BE TOTALLY ENCAPSULATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822.
6. 4-U BARS OF REINFORCING STEEL AT CENTER SUPPORT, 2-U BARS AT OTHER SUPPORTS.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

ANCHOR FOR 20" THRU 60" BENDS

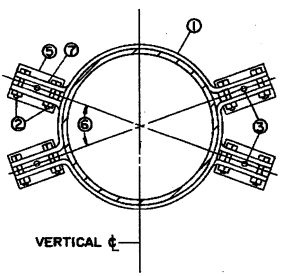
DESIGNED BY E. Kalina DRAWN BY M.A.D.L.P
CHECKED BY W. Faerber DATE 4-9-1986
APPROVED R.P. Koch
APPROVED [signature] DRWG. NO. 12



ELEVATION

SECTION A-A
4"-8" DIA.

① 1/2" X 2" RETAINER CLAMP
② 1/2" x 3 1/2 BOLT
③ 3/4" THREADED ROD
④ NUT
⑤ 1/2" x 3" x 5" WASHER
⑥ 12"-45°, 16"-30°
⑦ SECOND RETAINER CLAMP, 12" & 16" DIA.



SECTION A-A
12" & 16" DIA.

PIPE SIZE	PIPE O.D.	NO. RODS	"Z"	"X"
4"	4.80"	2	4.25"	6.25"
6"	6.90"	2	5.25"	7.25"
8"	9.05"	2	6.50"	8.50"
12"	13.20"	4	8.75"	10.75"
16"	17.40"	4	10.75"	12.75"

ALTERNATE-12" & 16"

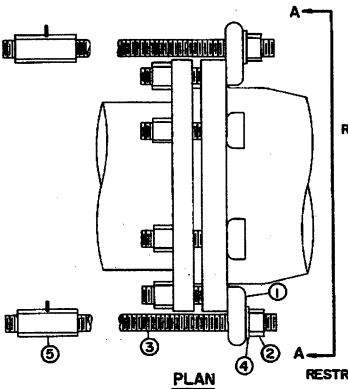
PIPE SIZE	NO. RODS	CLAMP	BOLT	ROD
12"	2	1/2" x 2 1/2"	1"	1"
16"	2	1/2" x 3"	1"	1 1/4"

NOTES:
1. POLYETHYLENE FILM ENVELOPE NOT SHOWN
2. AFTER ASSEMBLY, ALL FERROUS MATERIALS OUTSIDE OF THE POLYETHYLENE ENVELOPE SHALL BE FULLY ENCAPSULATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822
3. ALL RESTRAINT MATERIALS SHALL BE HIGH STRENGTH, LOW ALLOY STEEL CONFORMING TO ASTM A-242

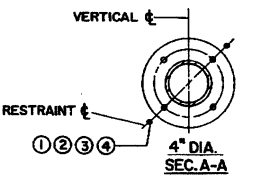
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

BELL RESTRAINT DETAILS
PUSH-ON AND LEAD JOINTS

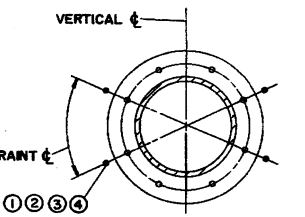
DESIGNED BY G. Kelley DRAWN BY D.L.P., G.R.H.
CHECKED BY W. Towey DATE 4-4-86
APPROVED
APPROVED DRWG. NO. 13



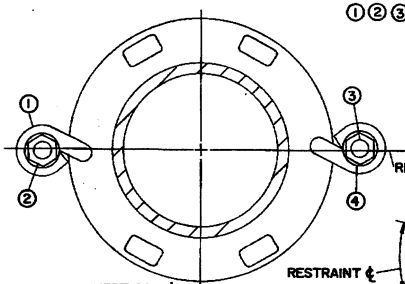
PLAN



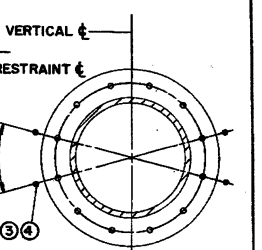
4" DIA.
SEC. A-A



12" DIA.
SEC. A-A



6" & 8" DIA.
SEC. A-A



16" DIA.
SEC. A-A

NOTES:

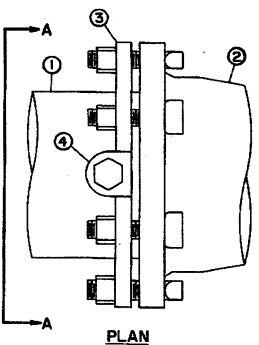
1. SEE SECTION 5.3.19 REGARDING USE OF SUPERSTAR RESTRAINT COMPONENTS.
2. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
3. AFTER ASSEMBLY, ALL FERROUS MATERIALS OUTSIDE OF THE POLYETHYLENE ENVELOPE SHALL BE TOTALLY ENCAPSULATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822.
4. SUPERSTAR IS THE TRADE NAME FOR RESTRAINT COMPONENTS PRODUCED BY STAR NATIONAL PRODUCTS OF COLUMBUS, OHIO.
5. 4"-8" DIA., 2 RODS REQUIRED; 12" & 16" DIA., 4 RODS REQUIRED.
6. ALL RESTRAINT MATERIALS SHALL BE HIGH STRENGTH, LOW ALLOY STEEL CONFORMING TO ASTM A-242.

① 3/4 INCH SUPERSTAR TIEBOLT
② 3/4 INCH SUPERSTAR TIENUT
③ 3/4 INCH FULLY THREADED ROD
④ WASHER
⑤ SUPERSTAR TIE COUPLING (IF REQUIRED)

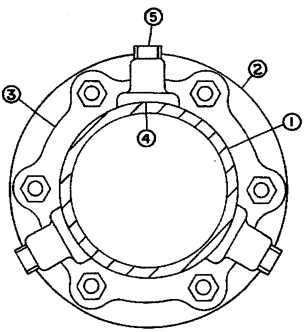
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

BELL RESTRAINT DETAILS
MECHANICAL JOINTS 4"-16"

DESIGNED BY Kenneth Allen DRAWN BY D.L.P., G.R.H.
CHECKED BY Walter Glover DATE 4-8-86
APPROVED E.J. Kaul
APPROVED [illegible] DRWG. NO. 14



PLAN
6" DIA.



SEC. A-A
6" DIA.

① M.J. SPIGOT D.I. PIPE
② M.J. BELL
③ MEGALUG FOLLOWER GLAND AND WEDGE ASSEMBLY
④ WEDGE ASSEMBLY
⑤ TWIST-OFF NUT

PIPE SIZE	NO. OF MEGALUG WEDGES
4"	2
6"	3
8"	4
12"	8
16"	12

NOTES:

1. SEE SECTION 5.3.19 REGARDING USE OF MEGALUG RESTRAINT COMPONENTS.
2. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
3. AFTER ASSEMBLY THE MEGALUG FOLLOWER GLAND AND WEDGE ASSEMBLY SHALL BE TOTALLY ENCAPSULATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822. THE ASSEMBLY SHALL THEN BE ENCASED IN THE POLYETHYLENE FILM ENVELOPE.
4. MEGALUG IS THE TRADE NAME FOR RESTRAINT COMPONENTS PRODUCED BY EBAA IRON INC. OF EASTLAND, TEXAS.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

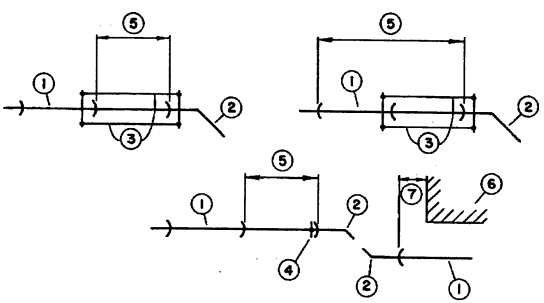
BELL-SPIGOT RESTRAINT DETAILS
MECHANICAL JOINTS 4"-16"

DESIGNED BY [signature] DRAWN BY D.L.P.,G.R.H.
CHECKED BY [signature] DATE 4-9-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 15

PIPE DIA.	BENDS		OFFSETS			
	DEGREE OF BEND		OFFSET DIMENSION			
	22 1/2°	45°	6"	12"	18"	24"
4"	6'	12'	10'	14'	16'	-
6"	8'	16'	12'	16'	20'	35'
8"	12'	20'	16'	22'	24'	35'
12"	15'	26'	18'	24'	27'	35'
16"	18'	36'	19'	26'	30'	-

NOTE:
LENGTH TO BE RESTRAINED BASED ON WATER PRESSURE OF 150 PSI, BACKFILL IN PLACE AND PIPE DOUBLE WRAPPED IN POLYETHYLENE.

LENGTHS IN FEET OF PIPE TO BE RESTRAINED AT CHANGES IN DIRECTIONS



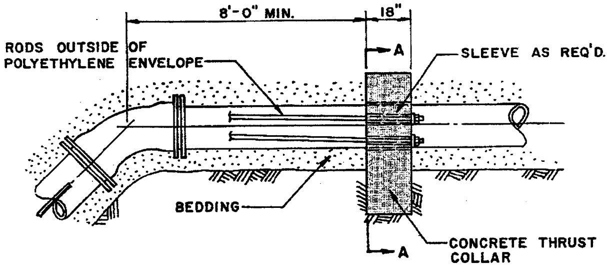
RESTRAINED LENGTHS - TYPICAL SITUATIONS

① WATER MAIN
② FITTING (BEND OR OFFSET)
③ BELL RESTRAINT TO BELL RESTRAINT (SEE DRAWINGS NO.S 13 AND/OR 14)
④ BELL-SPIGOT RESTRAINT, M.J. (SEE DRAWING NO. 15)
⑤ LENGTH OF PIPE RESTRAINED
⑥ UNDERGROUND OBSTRUCTION
⑦ MINIMUM JOINT CLEARANCE = 2'

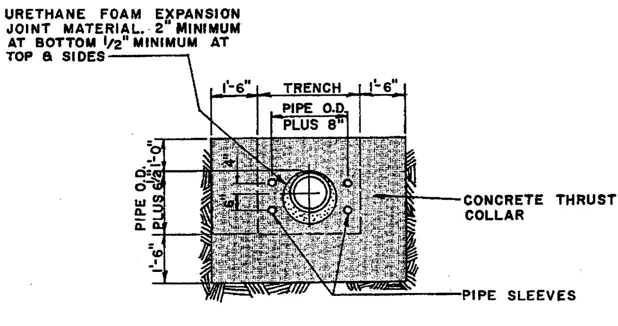
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

RESTRAINED LENGTHS
4"-16" BENDS & OFFSETS

DESIGNED BY _____ DRAWN BY VG/DLP
CHECKED BY _____ DATE 12-16-86
APPROVED _____
APPROVED _____ DRWG. NO. 16



ELEVATION



SECT. A-A

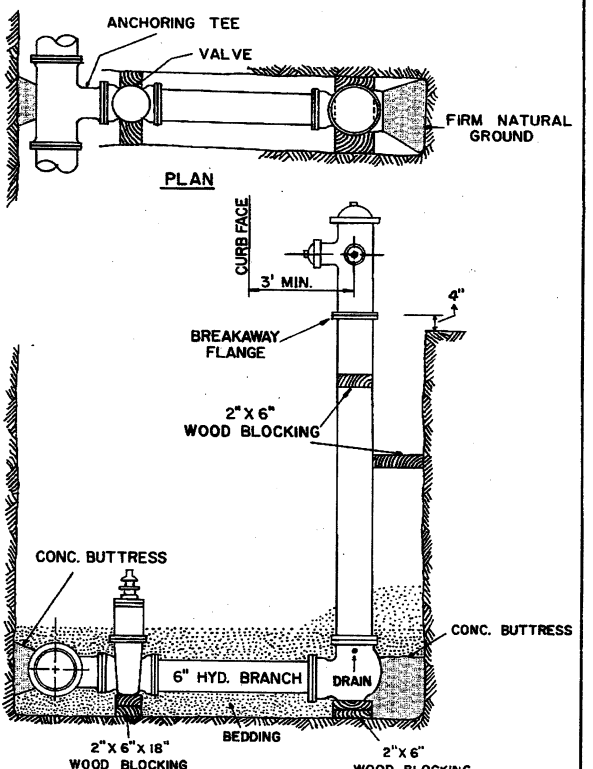
NOTES

1. THRUST COLLAR DESIGN BASED ON WATER PRESSURE OF 150 PSI AND ON SOIL BEARING PRESSURE OF 4000 LBS. PER SQ. FT.
2. CONCRETE TO BE CLASS "A" OR H.E.S.
3. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND.
4. FOR RODS AND ATTACHING DETAILS SEE DRW'GS. NO. 13 AND NO. 14
5. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
6. AFTER ASSEMBLY ALL FERROUS MATERIALS OUTSIDE OF THE POLYETHYLENE ENVELOPE SHALL BE TOTALLY ENCAPSULATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822
7. FOR 6" OR 8", ONE PAIR OF RODS WOULD BE REQUIRED.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

THRUST COLLARS
12" AND 16" BENDS.

DESIGNED BY E. Kalisz DRAWN BY DLP, JAS
CHECKED BY Walter Cohen DATE 1-21-86
APPROVED
APPROVED DRWG. NO. 17

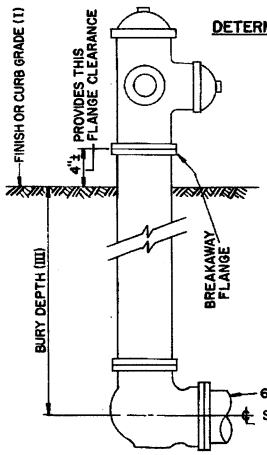


NOTES:

1. CONCRETE TO BE POURED AGAINST FIRM NATURAL GROUND.
2. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
3. HYDRANT TO BE VERTICAL WITHIN $\frac{1}{8}$" PER FOOT.
4. ALL CONCRETE TO BE CLASS 'F'.

BUREAU OF ENGINEERS WATER ENGINEERING DIVISION DEPARTMENT OF PUBLIC WORKS MILWAUKEE, WISCONSIN	
TYPICAL HYDRANT SETTING	
DESIGNED BY E. Kelley	DRAWN BY M.A
CHECKED BY [illegible]	DATE 2-6-1986
APPROVED [illegible]	
APPROVED [illegible]	DRWG. NO. 18

DETERMINING HYDRANT BURY LENGTHS



I ESTABLISHED FINISH OR CURB GRADE WHICHEVER IS HIGHER.

II ESTABLISHED SHOE GRADE.

III SUBTRACT ELEVATION II FROM ELEVATION I. THIS IS THE BURY DEPTH.

IV ADD FOUR INCHES TO LENGTH OBTAINED IN III. THIS IS THE AWWA BURY LENGTH NEEDED. IT PROVIDES 4" FLANGE CLEARANCE.

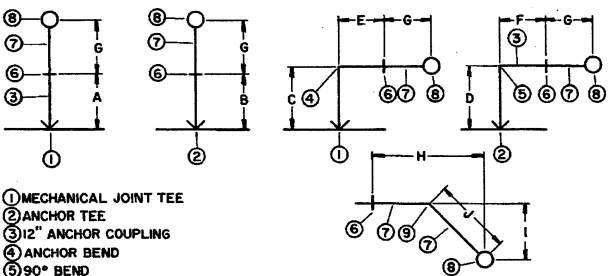
V IF LENGTH CALLED FOR IN IV IS OVER 1" MORE THAN STANDARD AWWA BURY LENGTH, USE NEXT LONGER HYDRANT LENGTH.

NOTE:
POLYETHYLENE FILM ENVELOPE NOT SHOWN.

TABLE OF 6" HYDRANT BRANCH DIMENSIONS

MAIN SIZE	MINIMUM DIMENSIONS-FT.										BEND
	A	B	C*	D	E*	F	G	H	I	J	
6"	1.9	1.1	1.6/2.0	1.6	1.6/1.2	1.9	1.8	3.6	0.4	1.9	11 1/4°
8"	2.0	1.2	1.7/2.1	1.7	1.6/1.2	1.9	1.8	3.4	0.8	2.0	22 1/2°
12"	2.2	1.5	1.9/2.3	1.9	1.6/1.2	1.9	1.8	3.2	1.4	1.9	45°
16"	2.5	1.7	2.2/2.6	2.1	1.6/1.2	1.9	1.8				

*DIMENSION DEPENDENT ON ORIENTATION OF ANCHOR BEND



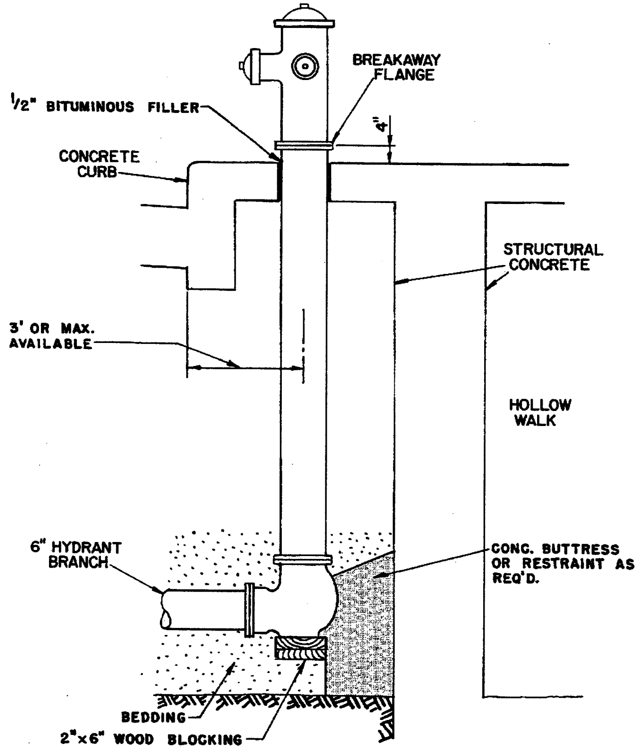
(1) MECHANICAL JOINT TEE
(2) ANCHOR TEE
(3) 12" ANCHOR COUPLING
(4) ANCHOR BEND
(5) 90° BEND
(6) MECHANICAL JOINT VALVE
(7) 12" SPIGOT/SPIGOT CUT PIECE
(8) HYDRANT
(9) BEND

NOTE:
HYDRANT BRANCH DIMENSIONS SHOW ONLY MINIMUM BRANCH LENGTHS FOR NEW CONSTRUCTION. SPECIFIC HYDRANT BRANCH DESIGN IS SHOWN ON THE PLAN.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

HYDRANT BRANCH DETAILS

DESIGNED BY E. Kubis DRAWN BY D.L.P., G.R.H.
CHECKED BY W. Gouras DATE 2-12-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 19



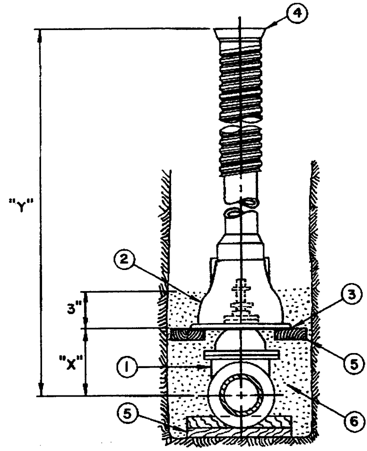
NOTES

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. STRUCTURAL CONCRETE SHALL BE CLASS "A"
3. BUTTRESS CONCRETE SHALL BE CLASS "F"
4. TURN NOZZLE FROM CURB IF NECESSARY FOR CLEARANCE

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

TYPICAL HYDRANT SETTING AT HOLLOW WALK

DESIGNED BY ______ DRAWN BY DLP JAS
CHECKED BY ______ DATE 4-10-86
APPROVED ______
APPROVED ______ DRWG. NO. 20



PIPE DIA.	"X" SETTING		"Y"- DISTANCE FROM BOX TOP TO PIPE CENTER LINE					
			D FT.	DD FT.	F FT.	D-EXT. FT.	DD-EXT. FT.	F-EXT. FT.
2"	6"	MIN. MAX.	4.5 5.9	5.0 6.4	6.3 7.3	5.1 6.5	5.6 7.0	6.9 7.9
3"	7"	MIN. MAX.	4.5 5.9	5.0 6.4	6.4 7.4	5.1 6.5	5.6 7.0	7.0 8.0
4"	8"	MIN. MAX.	4.6 6.0	5.1 6.5	6.5 7.5	5.2 6.6	5.7 7.1	7.1 8.1
6"	1'-0"	MIN. MAX.	4.9 6.4	5.5 6.9	6.8 7.8	5.5 7.0	6.1 7.5	7.4 8.4
8"	1'-2"	MIN. MAX.	5.1 6.5	5.6 7.0	7.0 8.0	5.7 7.1	6.2 7.6	7.6 8.6
12"	1'-9"	MIN. MAX.	5.7 7.1	6.2 7.6	7.5 8.5	6.3 7.7	6.8 8.2	8.1 9.1
16"	2'-6"	MIN. MAX.	6.5 7.9	7.0 8.4	8.3 9.3	7.1 8.5	7.6 9.0	8.9 9.9

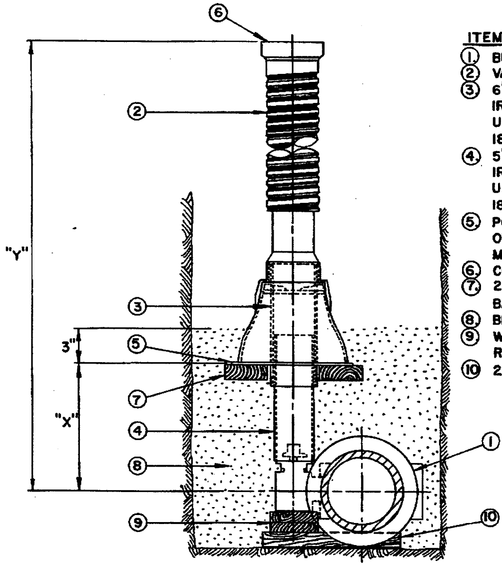
NOTES

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. D, DD AND F ARE STANDARD SIZE IDENTIFICATIONS FOR VALVE BOXES.
3. THE ABOVE TABLE IS BASED UPON USE OF EXTENSIONS OF 14" OVERALL LENGTH. IF AN 18" OR 20" EXTENSION IS USED, THE "Y" MAXIMUM CAN BE INCREASED 0.3' AND 0.4' RESPECTIVELY.
4. ITEMS ①,② AND ④ FURNISHED BY CITY ON CITY CONTRACTS.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

GATE VALVE & BOX SETTING

DESIGNED BY E. Kaliz DRAWN BY M.A., D.L.P.
CHECKED BY W. Pawn DATE 12-11-86
APPROVED
APPROVED DRWG. NO. 21



ITEM

1. BUTTERFLY VALVE
2. VALVE BOX
3. 6" GALVANIZED IRON OR 6" SCHEDULE 40 PVC PIPE 18" LONG.
4. 5" GALVANIZED IRON OR 5" SCHEDULE 40 PVC PIPE 18" LONG.
5. POLYETHYLENE OR OTHER APPROVED MATERIAL.
6. COVER
7. 2 x 6 x 18 WOOD BASE
8. BEDDING
9. WOOD BASE AS REQUIRED
10. 2 x 6 WOOD BASE

PIPE DIA.	"X" SETTING	"Y" DISTANCE FROM BOX TOP TO PIPE CENTER LINE						
			D FT.	DD FT.	F FT.	D-EXT. FT.	DD-EXT. FT.	F-EXT. FT.
12"	1'-5"	MIN. MAX.	5.4 6.8	5.9 7.3	7.3 8.3	6.1 7.5	6.6 8.0	8.0 9.0
16"	1'-7"	MIN. MAX.	5.5 6.9	6.0 7.4	7.4 8.4	6.2 7.6	6.7 8.1	8.1 9.1

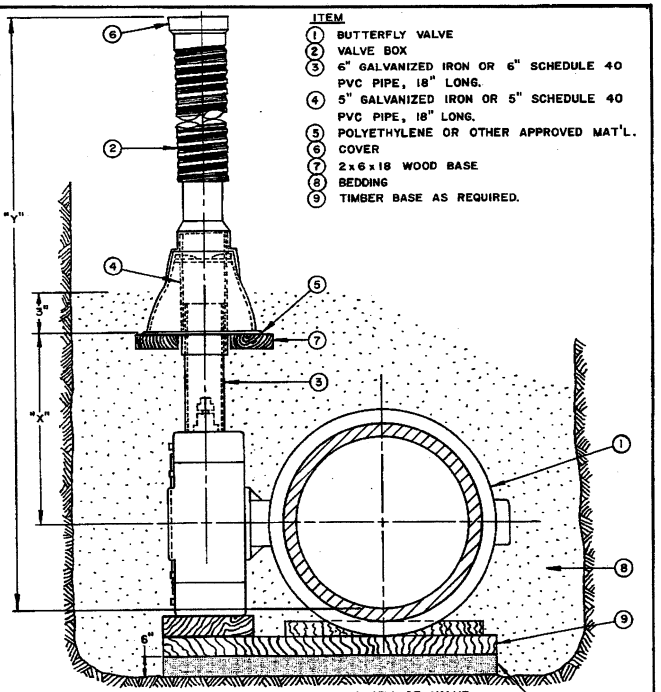
NOTES

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. D, DD AND F ARE STANDARD SIZE IDENTIFICATIONS FOR VALVE BOXES.
3. THE ABOVE TABLE IS BASED UPON USE OF EXTENSIONS OF 14" OVERALL LENGTH. IF AN 18" OR 20" EXTENSION IS USED, THE "Y" MAXIMUM CAN BE INCREASED 0.3' AND 0.4' RESPECTIVELY.
4. ITEMS (1), (2), (3), (4) AND (6) FURNISHED BY CITY ON CITY CONTRACTS.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

SETTING BUTTERFLY VALVES AND BOXES, 12" AND 16"

DESIGNED BY E. Kaliez DRAWN BY M.A., D.L.P.
CHECKED BY W. Powell DATE 12-11-86
APPROVED
APPROVED DRWG. NO. 22



PIPE DIA.	"X"	"Y" DIST. FROM BOX TOP TO PIPE FLOWLINE (FT.)						
			D FT.	DD FT.	F FT.	D-EXT. FT.	DD-EXT. FT.	F-EXT. FT.
20"	1' 2"	MIN.	6.0	6.5	7.8	6.7	7.2	8.5
		MAX.	7.4	7.9	8.8	8.1	8.6	9.5
24"	1' 4"	MIN.	6.3	6.8	8.1	7.0	7.5	8.8
		MAX.	7.7	8.2	9.1	8.2	8.9	9.8
30"	1' 8"	MIN.	6.9	7.4	8.7	7.6	8.1	9.4
		MAX.	8.3	8.8	9.7	9.0	9.5	10.4
36"	1' 10"	MIN.	7.3	7.8	9.1	8.0	8.5	9.8
		MAX.	8.7	9.2	10.1	9.4	9.9	10.8
42"	2' 0"	MIN.	7.7	8.2	9.6	8.4	8.9	10.3
		MAX.	9.1	9.6	10.5	10.0	10.3	11.2
48"	2' 6"	MIN.	8.5	9.0	10.3	9.2	9.7	11.0
		MAX.	9.9	10.4	11.3	10.6	11.1	12.0
54"	2' 6"	MIN.	8.7	9.2	10.6	9.4	9.9	11.3
		MAX.	10.1	10.6	11.7	10.8	11.3	12.2

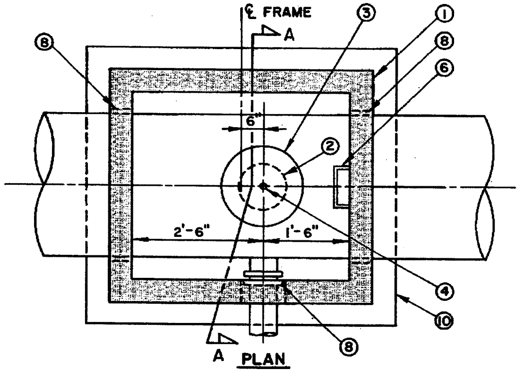
NOTES

1. VALVE TO BE SET SO SEAT ADJUSTMENT FACES NEAREST MANWAY.
2. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
3. CONCRETE SHALL BE CLASS "F".
4. D, DD, AND F ARE STANDARD SIZE IDENTIFICATIONS FOR VALVE BOXES.
5. THE ABOVE TABLE IS BASED UPON USE OF EXTENSIONS OF 14" OVERALL LENGTH. IF AN 18" OR 20" EXTENSION IS USED, THE "Y" MAXIMUM CAN BE INCREASED 0.3' AND 0.4' RESPECTIVELY.
6. ITEMS (1), (2), (3), (4) AND (6) FURNISHED BY CITY ON CITY CONTRACTS.

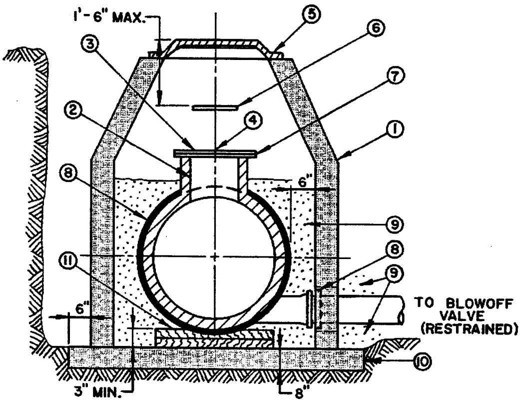
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

SETTING BUTTERFLY VALVES AND BOXES, 20" THROUGH 60"

DESIGNED BY E. Kalus DRAWN BY M.A. D.L.P.
CHECKED BY W. Davis DATE 12-11-86
APPROVED
APPROVED DRWG. NO. 23



PLAN



SECTION A-A

ITEMS

① MANHOLE (SEE SEC. 5.3.20)
② 20" INSPECTION MANWAY
③ BLIND FLANGE
④ TAP, 1-1/2" CORP. STOP THREADS
⑤ 30-1/2" MANHOLE FRAME AND LID.
⑥ MANHOLE STEP, 16" C-C
⑦ FLANGE GASKET
⑧ 2" FLEXIBLE RESILIENT MAT'L.
⑨ BEDDING
⑩ CONCRETE BASE
⑪ 2 x 6 WOOD BASE

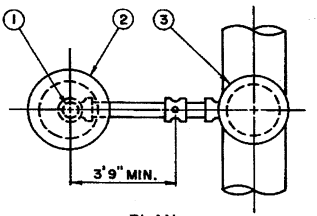
NOTES

1 POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2 CONCRETE SHALL BE CLASS "D."
3 ITEMS ⑤ AND ⑥ FURNISHED BY CITY, ON CITY CONTRACTS.

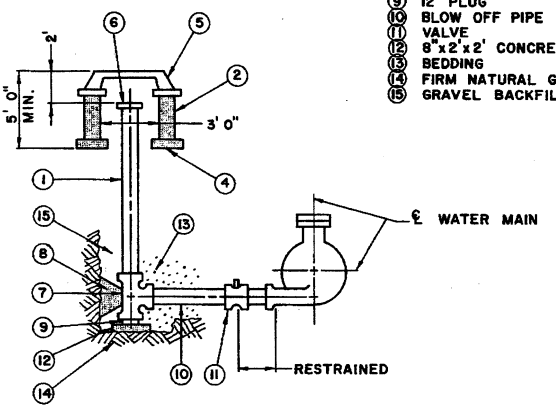
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

TYPICAL INSPECTION
MANHOLE (WITH BLOWOFF)

DESIGNED BY E. Kalisz DRAWN BY DLP/VRG
CHECKED BY W. Power DATE 2-18-86
APPROVED R. B. Kocol
APPROVED J. Langevel DRWG. NO. 24



PLAN



ELEVATION

1. 12" RISER PIPE
2. RISER MANHOLE (SEE SEC. 5.3.20)
3. INSPECTION MANHOLE (SEE DRWG. NO. 24)
4. 8"x2' CONCRETE BASE
5. STANDARD 30 1/2" FRAME AND LID
6. 12" RISER CAP
7. 12" TEE
8. STANDARD BUTTRESS (SEE DRWG. NO. 5)
9. 12" PLUG
10. BLOW OFF PIPE
11. VALVE
12. 8"x2'x2' CONCRETE BASE
13. BEDDING
14. FIRM NATURAL GROUND
15. GRAVEL BACKFILL

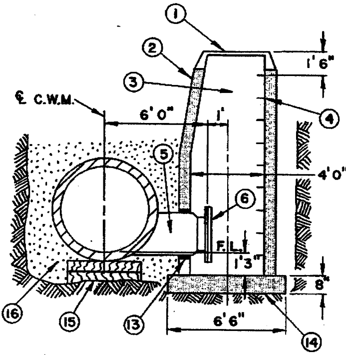
NOTES

1. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON PIPE NOT SHOWN.
2. CONCRETE TO BE CLASS "D"
3. ITEMS ⑤⑥⑦⑨ AND ⑪ TO BE FURNISHED BY CITY ON CITY CONTRACTS.

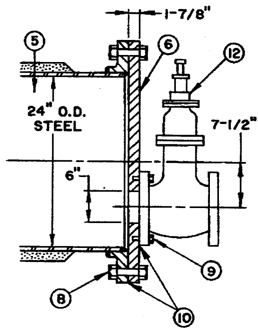
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

TYPICAL BLOWOFF AND RISER PIPE MANHOLE

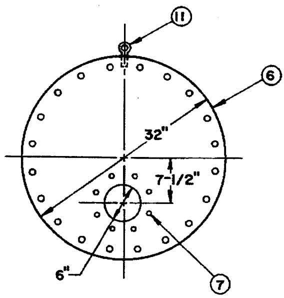
DESIGNED BY E. Kalisz DRAWN BY DLP/VRG
CHECKED BY G. Fowler DATE 12-15-86
APPROVED
APPROVED DRWG. NO. 25



VERTICAL SECTION



VALVE ASSEMBLY DETAIL



FLANGE DETAIL

ITEM

1. 30-1/2" FRAME AND LID.
2. MANHOLE (SEE SEC. 5.3.20).
3. INSTALL ONE 2" PIPE HANGER AS EXTENSION ROD HOLDER.
4. MANHOLE STEPS, 16" ON CENTERS.
5. 24" FLANGED MANWAY.
6. 24" FLANGE CONFORMING IN DIMENSIONS AND DRILLING TO ANSI B16.1 FOR CAST IRON, CLASS 125. THE FLANGE SHALL BE IN ACCORDANCE WITH A.W.W.A. C207.
7. TAP FOR 3/4" BOLTS-1" DEEP. (USE BOTTOMING TAP)
8. STAINLESS STEEL BOLTS 1-1/4" x 4" LONG.
9. STAINLESS STEEL BOLTS 3/4" x 2" LONG, GREASE THREADS.
10. 1/16" FIBER GASKET. (SEC. 4.4.7)
11. 3/4" THREADED EYE BOLT - 1-3/4" SHANK LENGTH.
12. 6" FLANGED GATE VALVE MOUNTED VERTICALLY, 2" A.W.W.A. NUT.
13. 2" OF FLEXIBLE RESILIENT MATERIAL (SEE SEC. 4.4.13).
14. CONCRETE BASE.
15. WOOD BASE.
16. BEDDING.

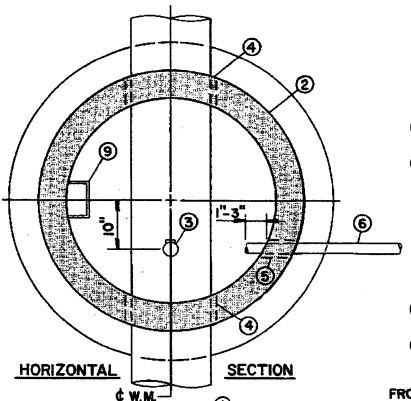
NOTES

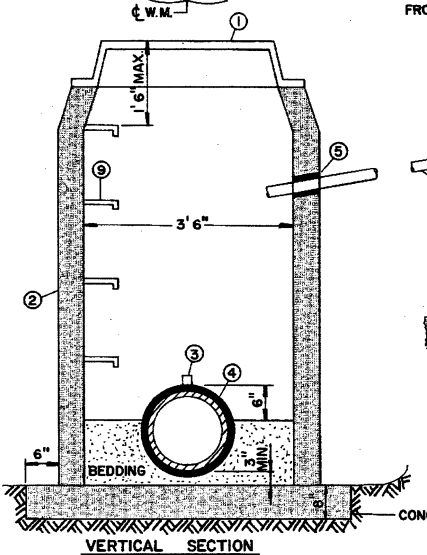
1. CONCRETE SHALL BE CLASS "D."
2. ITEMS (1) AND (4) FURNISHED BY CITY ON CITY CONTRACTS.
3. FERROUS SURFACES TO BE COATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

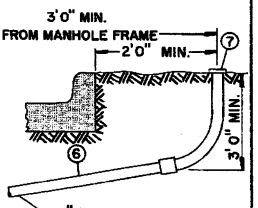
SIDE INLET BLOWOFF AND INSPECTION MANHOLE, CONCRETE MAIN

DESIGNED BY E. Kalisz DRAWN BY DLP/VRG
CHECKED BY W. Pokris DATE 12-15-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 26

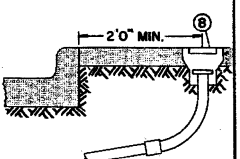




① 30 1/2" MANHOLE FRAME AND LID
② MANHOLE (SEE SEC. 5.3.20)
③ 1" MODIFIED CORPORATION STOP
④ 2" FLEXIBLE RESILIENT MATERIAL (SEE SEC. 4.4.13)
⑤ 2 LAYERS ROOFING FELT
⑥ 2 1/2" CONDUIT PIPE AND FITTINGS
⑦ 2 1/2" CONDUIT CAP, FLUSH WITH GROUND IN UNPAVED AREA
⑧ VALVE BOX TOP AND COVER
⑨ MANHOLE STEPS, 16" O.C.



SECTION - CONDUIT CAP IN SOIL



SECTION - CONDUIT CAP IN CONCRETE

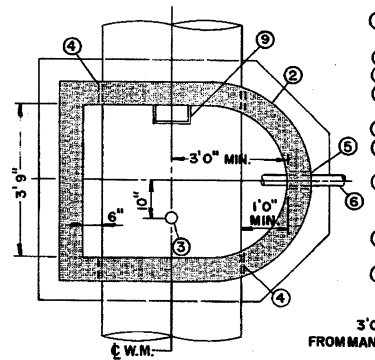
CONCRETE BASE ON FIRM NATURAL GROUND

NOTES:
1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. CONCRETE SHALL BE CLASS 'D'
3. ALL THREADED PORTIONS OF CONDUIT PIPE AND FITTINGS, SHALL BE COATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822.
4. ITEMS ①, ③, ⑥, ⑦, ⑧ AND ⑨ FURNISHED BY THE CITY ON CITY CONTRACTS

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

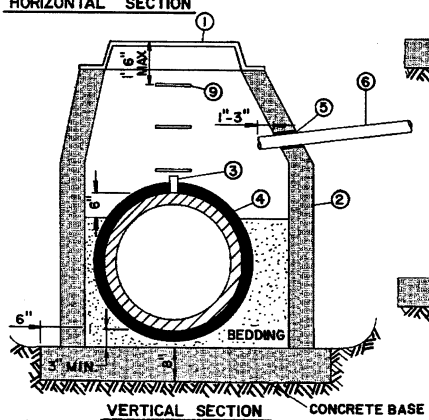
PITOMETER MANHOLE
12" THROUGH 20" MAIN

DESIGNED BY [signature] DRAWN BY D.L.P.G.R.H.
CHECKED BY [signature] DATE 2-18-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 27

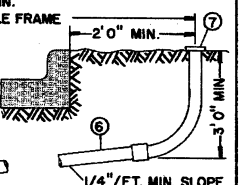


HORIZONTAL SECTION

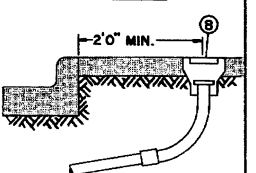
① 30 1/2" MANHOLE FRAME AND LID
② MANHOLE (SEE SEC. 5.3.20)
③ 1" MODIFIED CORPORATION STOP
④ 2" FLEXIBLE RESILIENT MATERIAL (SEE SEC. 4.4.13)
⑤ 2 LAYERS ROOFING FELT
⑥ 2 1/2" CONDUIT PIPE AND FITTINGS
⑦ 2 1/2" CONDUIT CAP, FLUSH WITH THE GROUND IN UNPAVED AREA
⑧ VALVE BOX TOP AND COVER
⑨ MANHOLE STEPS, 16" O.C.



VERTICAL SECTION



SECTION- CONDUIT CAP IN SOIL



SECTION - CONDUIT CAP IN CONCRETE

CONCRETE BASE ON FIRM NATURAL GROUND

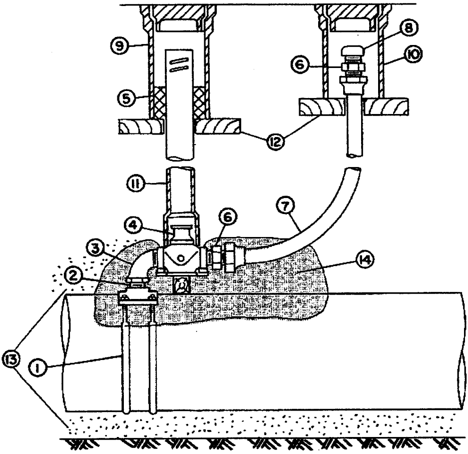
NOTES:

1. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON NOT SHOWN
2. CONCRETE SHALL BE CLASS 'D'.
3. ALL THREADED PORTIONS OF CONDUIT PIPE AND FITTINGS, SHALL BE COATED WITH PLASTIC ROOFING CEMENT CONFORMING TO ASTM D-2822
4. ITEMS ① ③ ⑥ ⑦ ⑧ AND ⑨ FURNISHED BY THE CITY ON CITY CONTRACTS.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

PITOMETER MANHOLE
FOR 24" & LARGER MAINS

DESIGNED BY [signature] DRAWN BY D.L.P. G.R.H.
CHECKED BY [signature] DATE 2-19-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 28



① SERVICE SADDLE, MUELLER 161 OR EQUAL
② BRONZE NIPPLE
③ BRONZE 90° STREET ELBOW
④ CURB STOP W/DRAIN
⑤ PACKING MATERIAL, YARN OR OAKUM
⑥ BRONZE ADAPTER, IP THREAD BY COPPER FLARE (2)
⑦ COPPER TUBING, TYPE 'K', FLARED
⑧ BRASS CAP
⑨ VALVE BOX TOP SECTION AND COVER
⑩ VALVE BOX ADJUSTING TOP SECTION AND SMALL COVER
⑪ SERVICE BOX BASE (3")
⑫ 2 x 6 WOOD BASE
⑬ BEDDING
⑭ CONCRETE ENCASEMENT

PIPE	CONNECTION
CONCRETE	FEMALE
4"-8" IRON	SERVICE SADDLE
12" & LARGER IRON	DRILL & TAP I.P. THREAD

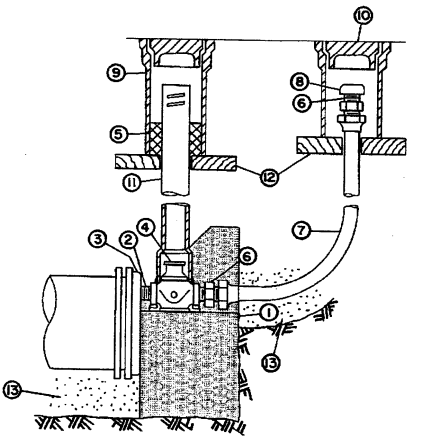
NOTES:

1. ALL BRONZE MATERIAL SHALL BE EXTRA HEAVY.
2. CONCRETE SHALL BE CLASS 'F'.
3. ITEMS ①,②,③,④,⑥,⑧,⑨,⑩ AND ⑪ FURNISHED BY THE CITY ON CITY CONTRACTS.
4. BRASS, BRONZE AND COPPER MATERIALS SHALL BE WRAPPED IN POLYETHYLENE FILM ENVELOPE.
5. POLYETHYLENE FILM ENVELOPE NOT SHOWN.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

1" OR 2" AIR VENT
TOP OF PIPE

DESIGNED BY E. Kaliss DRAWN BY D.L.P., G.R.H.
CHECKED BY W. Gonzi DATE 2-24-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 29



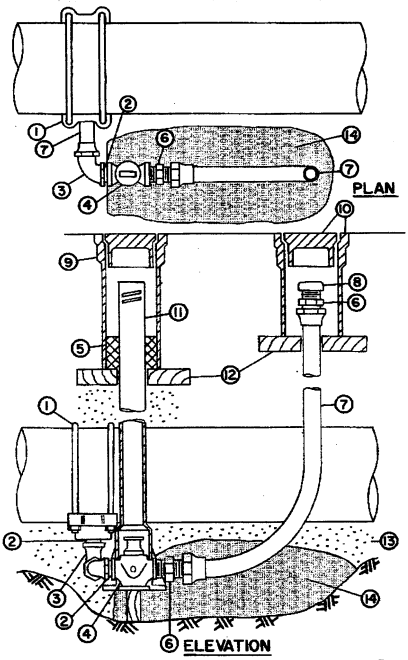
(1) CONCRETE BUTTRESS, NOTCH TO PROVIDE CLEARANCE FOR STOP. (SEE DRWGS. NO. 3 AND 4)
(2) BRONZE CLOSE NIPPLE
(3) TAPPED CAP OR PLUG
(4) CURB STOP W/DRAIN
(5) PACKING MATERIAL, YARN OR OAKUM
(6) BRONZE ADAPTER, I.P. THREAD BY COPPER FLARE (2)
(7) COPPER TUBING TYPE 'K', FLARED
(8) BRASS CAP
(9) VALVE BOX, TOP SECTION AND COVER
(10) VALVE BOX, ADJUSTING TOP SECTION AND SMALL COVER
(11) SERVICE BOX BASE (3")
(12) 2 x 6 WOOD BASE
(13) BEDDING

NOTES:
1. ALL BRONZE MATERIAL SHALL BE EXTRA HEAVY.
2. CONCRETE SHALL BE CLASS 'F'.
3. ITEMS (2), (3), (4), (6), (8), (9), (10), AND (11) FURNISHED BY THE CITY ON CITY CONTRACTS.
4. BRASS, BRONZE AND COPPER MATERIALS SHALL BE WRAPPED IN POLYETHYLENE FILM ENVELOPE.
5. POLYETHYLENE FILM ENVELOPE NOT SHOWN.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

1" OR 2" AIR VENT END OF MAIN

DESIGNED BY E. Kelling DRAWN BY D.L.P. G.R.H.
CHECKED BY W. Powers DATE 2-24-86
APPROVED
APPROVED DRWG. NO. 30



① SERVICE SADDLE, MUELLER 161 OR EQUAL
② BRONZE NIPPLE (2)
③ BRONZE 90° BEND, I.P. THREAD BY COPPER FLARE (2)
④ CURB STOP W/DRAIN
⑤ PACKING MATERIAL, YARN OR OAKUM
⑥ BRONZE ADAPTER I.P. THREAD BY COPPER FLARE (2)
⑦ COPPER TUBING, TYPE 'K', FLARED
⑧ BRASS CAP
⑨ VALVE BOX TOP SECTION AND COVER
⑩ VALVE BOX, ADJUSTING TOP SECTION AND SMALL COVER
⑪ SERVICE BOX BASE (3")
⑫ 2x6 WOOD BASE
⑬ BEDDING
⑭ CONCRETE ENCASEMENT

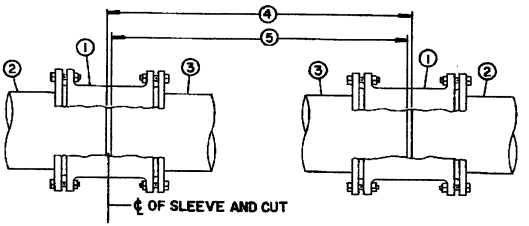
NOTES:
1. ALL BRONZE MATERIAL SHALL BE 2" SIZE, EXTRA HEAVY.
2. DO NOT PLACE CONCRETE BEYOND LIMITS INDICATED.
3. CONCRETE SHALL BE CLASS 'F'
4. ITEMS ①, ②, ③, ④, ⑥, ⑧, ⑨, ⑩ AND ⑪ FURNISHED BY THE CITY ON CITY CONTRACTS.
5. BRASS, BRONZE AND COPPER MATERIAL SHALL ALSO BE WRAPPED IN A POLYETHYLENE FILM ENVELOPE.

PIPE	CONNECTION
CONCRETE	FEMALE
4"-8" IRON	SERVICE SADDLE
12" & LARGER IRON	DRILL & TAP I.P. THREAD

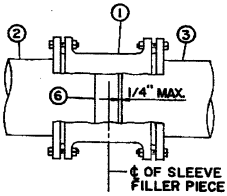
BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

2" BLOW-OFF DRAIN

DESIGNED BY W. Kellner DRAWN BY D.L.P. G.R.H.
CHECKED BY W.E. Boege DATE 2-21-86
APPROVED R. D. Ford
APPROVED W. Boege Jun. DRWG. NO. 31



TWO-SLEEVE ASSEMBLY



ONE-SLEEVE ASSEMBLY

① MECHANICAL JOINT OR MECHANICAL JOINT DUAL PURPOSE SLEEVE. SEE TABLE FOR APPLICATION
② EXISTING PIPE
③ NEW PIPE
④ OPENING IN EXISTING PIPE
⑤ NEW PIPE ASSEMBLY (MUST BE CUT TO EXACT MEASURED LENGTH OF OPENING IN EXISTING PIPE, TOLERANCE: -1/4, +0.)
⑥ FILLER PIECE

PIPE MATERIAL	TYPE OF JOINT	YEARS INSTALLED [9]	SIZES	CONNECTION REQUIREMENTS (SEE NOTES)
PIT CAST GRAY IRON	LEAD	1873-1929	4"-54"	D.P. OR L.J.
PIT CAST GRAY IRON	LT	1929-1945	4"-54"	D.P. OR L.J.
GRAY IRON	LT	1937 (T. OF LAKE)	6"-16"	M.J. [8]
PIT CAST GRAY IRON	LEAD	1945-1957	20"-54"	D.P. OR L.J.
CENTRIFUGAL CAST GRAY IRON	LEAD	1945-1964	4"-16"	M.J. [7]
CENTRIFUGAL CAST GRAY IRON	PUSH-ON RUBBER	1957-1964	4"-16"	M.J.
DUCTILE IRON	PUSH-ON RUBBER	1964-1986	4"-16"	M.J.

TABLE SHOWING TYPE OF EXISTING PIPE

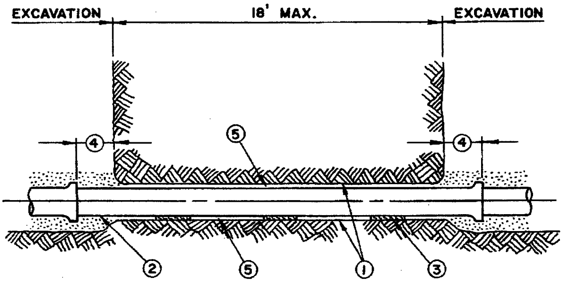
NOTES:

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. FILLER PIECES FOR 20" OR LARGER MAINS SHALL BE CONNECTED ON ONE END BY EQUALLY SPACED 2" MINIMUM TACK WELDS. (20" AND 24"-8 WELDS, 30" THRU 54"-16 WELDS)
3. D.P. DESIGNATES DUAL SIZE MECHANICAL JOINT SLEEVES. THESE ARE AVAILABLE IN SIZES UP TO 48".
4. L.J. DESIGNATES LEAD JOINT SLEEVES.
5. M.J. DESIGNATES STANDARD MECHANICAL JOINT SLEEVES.
6. LT DESIGNATES SULFUR COMPOUND JOINTS. LEADITE WAS USED IN THE CITY OF MILWAUKEE. MINERAL LEAD WAS USED IN THE FORMER TOWN OF LAKE SYSTEM.
7. 16" PIPE INSTALLED PRIOR TO 1962 HAS A LARGER O.D. AND WILL REQUIRE D.P. OR L.J. SLEEVES.
8. 16" PIPE MAY REQUIRE D.P. OR L.J. SLEEVES.
9. THERE MAY BE SOME VARIATION IN THE BOUNDARY YEARS.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

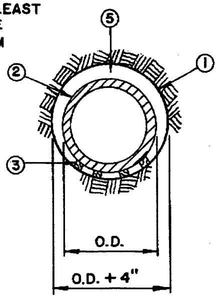
CONNECTION ASSEMBLIES
CAST AND / OR DUCTILE IRON

DESIGNED BY T.J. Miller DRAWN BY D.L.P., G.R.H.
CHECKED BY A.C. Tegen DATE 2-20-86
APPROVED [illegible]
APPROVED [illegible] DRWG. NO. 32



ELEVATION

1. BORED HOLE IN EARTH
2. WATER MAIN
3. MINIMUM OF 3 SETS PER PIPE LENGTH OF WOOD CARRIERS AT LEAST 12" LONG WIRED OUTSIDE OF POLYETHYLENE FILM ENVELOPE.
4. 1' MINIMUM, 2' MAXIMUM
5. CELLULAR CONCRETE OR CONCRETE SLURRY.

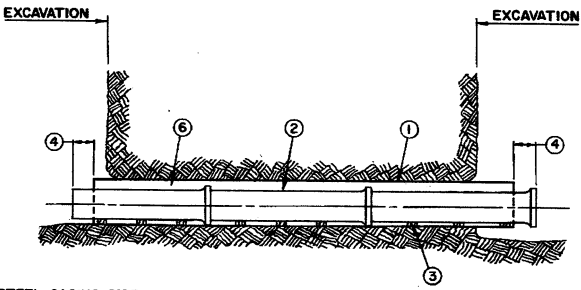


SECTION

NOTES

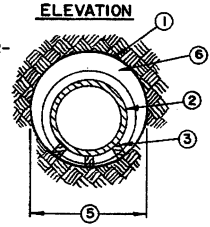
1. NO JOINTS PERMITTED WITHIN THE BORE.
2. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
3. FILL THE VOID BETWEEN WATER MAIN AND BORED HOLE BY PUMPING CELLULAR CONCRETE OR CONCRETE SLURRY.

BUREAU OF ENGINEERS WATER ENGINEERING DIVISION DEPARTMENT OF PUBLIC WORKS MILWAUKEE, WISCONSIN
BORING WITHOUT CASING PIPE
DESIGNED BY ____ DRAWN BY DLP/VRG CHECKED BY ____ DATE 12-18-86 APPROVED ____ APPROVED ____ DRWG. NO. 33



ELEVATION

1. STEEL CASING PIPE
2. WATER MAIN
3. MINIMUM OF 3 SETS PER PIPE LENGTH OF WOOD CARRIERS AT LEAST 12" LONG WIRED OUTSIDE OF POLYETHYLENE FILM ENVELOPE.
4. 1' MINIMUM, 2' MAXIMUM
5. CASING PIPE O.D.
6. CELLULAR CONCRETE OR CONCRETE SLURRY.



SECTION

STEEL CASING PIPE - ASTM A-53 GRADE B 35,000 PSI. MIN. YIELD		
PIPE SIZE	CASING PIPE	
	MIN. O.D.	NOM. WALL
6"	18"	0.312
8"	18"	0.312
12"	24"	0.406
16"	30"	0.469
20"	36"	0.563
24"	42"	0.563

NOTES

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. FILL THE VOID BETWEEN WATER MAIN AND CASING BY PUMPING CELLULAR CONCRETE OR CONCRETE SLURRY.
3. FIELD WELDS, IF REQUIRED, ON STEEL CONDUIT SECTIONS TO BE SINGLE-WELDED BUTT JOINT ACCORDING TO A.W.W.A. SPECS. C-206.
4. FOR PIPE 30" OR ABOVE CASING SHALL BE INDIVIDUALLY DESIGNED OR AS SHOWN ON THE PLAN.
5. SEE DRAWING NO. 35 FOR CONCRETE BULKHEAD WHEN REQUIRED.

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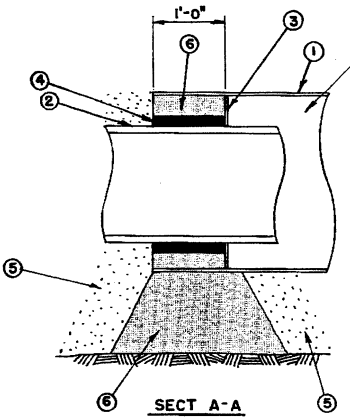
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

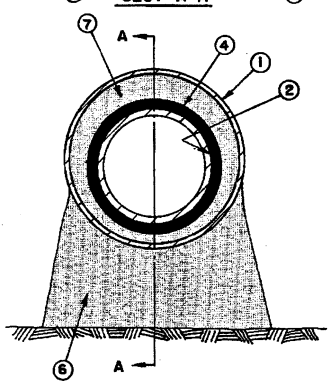
JACKING OR BORING WITH CASING PIPE

DESIGNED BY E. Kaliz DRAWN BY DLP/VRG
CHECKED BY W. Power DATE 12-16-86
APPROVED [illegible]
APPROVED [illegible] DRWG. NO. 34



SECT A-A

1. STEEL CASING PIPE
2. WATER MAIN
3. PLYWOOD FORM TO BE LEFT IN PLACE
4. 2" FLEXIBLE RESILIANT MATERIAL
5. BEDDING
6. CONCRETE
7. CELLULAR CONCRETE OR CONCRETE SLURRY



TRANSVERSE SECTION

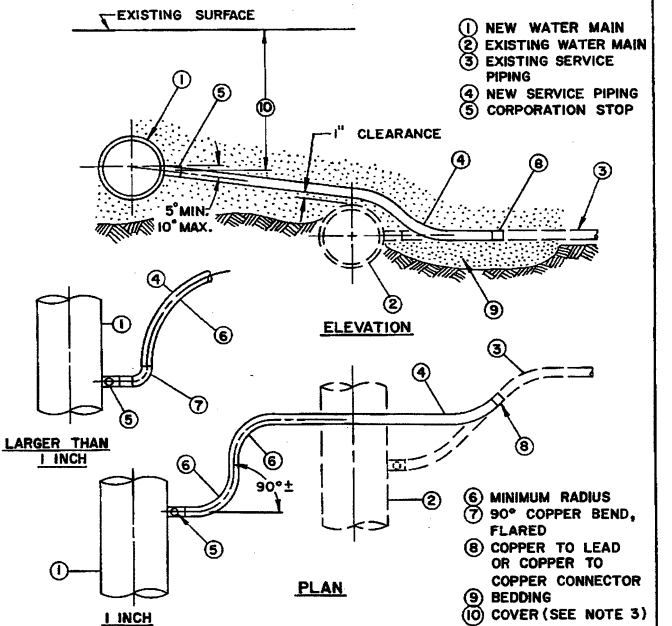
NOTES

1. POLYETHYLENE FILM ENVELOPE REQUIRED FOR DUCTILE IRON PIPE NOT SHOWN.
2. CONCRETE SHALL BE CLASS "F"
3. SEE DRAWING NO. 34 FOR CASING PIPE.

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

CONCRETE BULKHEAD
FOR STEEL CASING PIPE

DESIGNED BY E. Kalisz DRAWN BY DLP/JAS
CHECKED BY W. Grand DATE 4-10-86
APPROVED
APPROVED DRWG. NO. 35



NOTES

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. WATER SERVICE MAY BE INSTALLED UNDER EXISTING WATER MAIN.
3. IF MINIMUM COVER IS 6' OR LESS, THE NEW WATER SERVICE MUST BE INSULATED.
4. CONNECTIONS SHALL BE TESTED FOR LEAKAGE PRIOR TO BACKFILL.
5. COPPER TUBING SHALL BE TYPE "K".
6. PIPE BENDER SHALL BE USED. CONDUIT BENDER SHALL NOT BE USED.
7. ON 1", 90° COPPER BEND MAY BE USED ADJACENT TO THE CORPORATION STOP IF NECESSARY DUE TO SPACE LIMITATIONS.
8. SERVICE SADDLE REQUIRED FOR ALL TAPS IN 4" WATER MAIN.
9. COPPER TUBING SHALL BE WRAPPED WITH POLYETHYLENE FROM THE WATER MAIN FOR A DISTANCE OF 6 FEET OR TO THE TRENCH WALL.

SERVICE PIPING DETAILS

PIPE SIZE	CORP. STOP	CURB STOP	SERVICE BOX	MIN. RADIUS
1"	1"	1"	2-1/2"	6"
1-1/4"	1"x1-1/4"	1-1/4"	3"	8"
✳1-1/2"	1-1/2"	1-1/2"	3"	10"
✳ 2"	1-1/2"x2"	2"	3"	12"

✳ SERVICE SADDLE REQUIRED ON 6" WATER MAIN.

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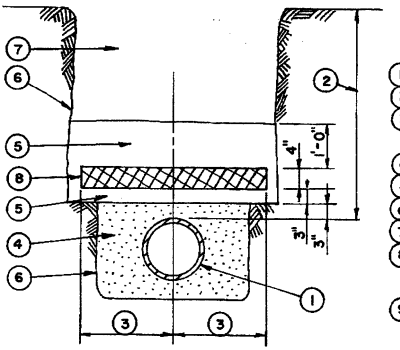
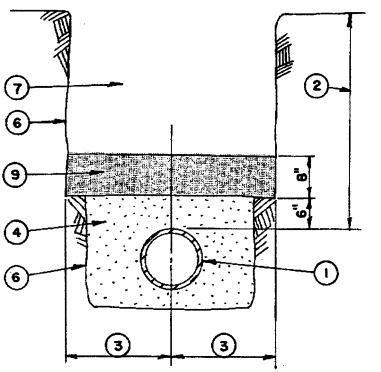
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

CONNECT ORIGINAL SERVICE ASSEMBLY

DESIGNED BY [signature] DRAWN BY DLP/VRS
CHECKED BY [signature] DATE 12-18-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 36



RIGID INSULATION



INSULATING CONCRETE

1. WATER MAIN
2. COVER, 4.5' MINIMUM
3. 1'-6" MIN.
4. BEDDING
5. MASON SAND
6. TRENCH WALL
7. BACKFILL
8. CLOSED CELL EXTRUDED POLYSTYRENE FOAM BOARDS
9. 1:8 MIX PERLITE OR VERMICULITE CONCRETE

NOTES:

1. POLYETHYLENE FILM ENVELOPE NOT SHOWN.
2. WHEN INSULATING CONCRETE IS USED, 8" ENCASEMENT OF THE PIPE MAY BE USED AS AN ALTERNATIVE CONFIGURATION WITH APPROVAL OF THE COMMISSIONER.
3. THIS DETAIL SHALL BE USED FOR WATER MAINS ONLY AND ONLY WITH THE EXPRESS APPROVAL OF THE WATER ENGINEERING DIVISION.

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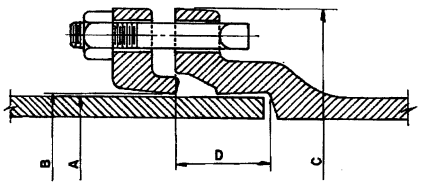
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

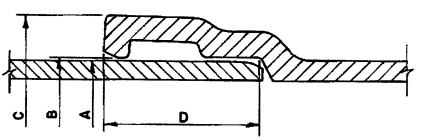
PIPE INSULATION DETAILS

DESIGNED BY [signature] DRAWN BY JAS, DLP
CHECKED BY [signature] DATE 12-18-86
APPROVED [signature]
APPROVED [signature] DRWG NO. 37



SIZE	PIPE O.D.	SOCKET I.D.	BELL O.D.	SOCKET DEPTH
	A	B	C	D
3"	3.96"	4.06"	7.69"	2.50"
4"	4.80"	4.90"	9.12	2.50"
6"	6.90"	7.00"	11.12"	2.50"
8"	9.05"	9.15"	13.37"	2.50"
12"	13.20"	13.30"	17.94"	2.50"
16"	17.40"	17.54"	22.56"	3.50"

DIMENSIONS OF MECHANICAL JOINTS
(FITTINGS ONLY - USED AFTER 1970)



SIZE	PIPE O.D.	SOCKET [1] I.D.	BELL [1] O.D.	SOCKET [1] DEPTH
	A	B	C	D
3"	3.96"	4.1"	6.0"	3.0"-3.2"
4"	4.80"	4.9"	7.1"	3.2"-3.4"
6"	6.90"	7.0"	9.5"	3.4"-3.6"
8"	9.05"	9.2"	12.0"	3.7"-3.9"
12"	13.20"	13.3"	16.5"	3.9"-4.4"
16"	17.40"	17.5"-17.6"	20.9"	4.7"-4.9"

DIMENSIONS OF PUSH-ON JOINT PIPE

1. VARIES WITH MANUFACTURER

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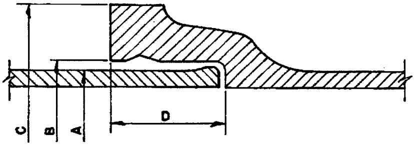
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

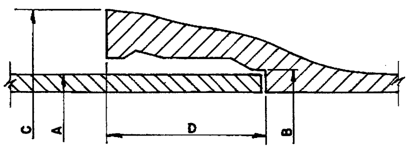
DIMENSIONS OF RUBBER JOINT IRON PIPE

DESIGNED BY [signature] DRAWN BY JAS DLP
CHECKED BY W.E. Bauer DATE 12-22-86
APPROVED [signature]
APPROVED [signature] DRWG. NO. 38



SIZE	CLASS	PIPE O.D.	SOCKET I.D.	BELL O.D.	SOCKET DEPTH
		A	B	C	D
3"	C	3.96"	4.76"	7.36"	3.50"
4"	C	5.00"	5.80"	8.40"	3.50"
6"	C	7.10"	7.90"	10.70"	3.50"
8"	C	9.30"	10.10"	13.10"	4.00"
12"	C	13.50"	14.30"	17.70"	4.00"
16"	C	17.80"	18.80"	22.60"	4.00"

DIMENSIONS OF PIT CAST PIPE



	SIZE	PIPE O.D.	SOCKET I.D.	BELL O.D.	SOCKET DEPTH
		A	B	C	D
	3"	3.96"	4.76"	7.26"	3.30"
	4"	4.80"	5.60"	8.20"	3.30"
	6"	6.90"	7.70'	10.40"	3.88"
	8"	9.05"	9.85"	12.75"	4.38"
	12"	13.20"	14.00"	17.20"	4.38"
	16"	17.40"	18.40"	21.90"	4.50"
1.	16"	17.80"	18.80"	22.52"	4.50"

DIMENSIONS OF CENTRIFUGAL CAST PIPE

1. MILWAUKEE STANDARD (AND A.W.W.A. OPTIONAL STANDARD) PRIOR TO 1962

BUREAU OF ENGINEERS
WATER ENGINEERING DIVISION
DEPARTMENT OF PUBLIC WORKS
MILWAUKEE, WISCONSIN

DIMENSIONS OF LEAD JOINT CAST IRON PIPE

DESIGNED BY T. P. Keller DRAWN BY JAS DLP
CHECKED BY W. E. Bowen DATE 12-22-86
APPROVED R. J. Kosef
APPROVED [illegible] DRW'G. NO. 39

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