

I N D E X

DIVISION E

GENERAL MATERIAL SPECIFICATIONS

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DIVISION E

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1. GENERAL:

All materials shall be new and of the grades specified and shall be the best of their respective kinds for the uses intended. The terms "approved" and "or approved equal" mean that the Engineer must be consulted and his approval given in writing before the material in question is purchased or installed in the work. The approval of any material by the Engineer does not mean the acceptance of the material actually furnished if it should be found defective or inadequate for the purpose intended. Prior to the installation of any herein specified materials, the material manufacturer shall submit a sworn statement that the material has been inspected, tested, and complies with all specification requirements. Said certification shall be submitted to and approved by the Engineer prior to the installation of the material. All materials installed under provisions of this contract must also be certified to having been manufactured in the United States of America or Canada.

2. SPECIAL MATERIALS:

Special brands or grades of materials or devices specified or shown on the drawings are named for the purpose of establishing a standard of quality and character desired. Other materials of quality and adaptability for the purpose for which they are intended may be substituted, but shall have written approval of the Engineer as to quality and adaptability before being incorporated in the work.

3. AGGREGATES:

Aggregates shall not contain strong alkali or organic material which gives a darker than "standard" color when tested in accordance with latest revision of ASTM C-40.

3.1 Fine Aggregate: Fine aggregate shall meet or exceed the requirement as specified in the current edition of the MDOT Standard Specifications for Construction.

Fine aggregate to be utilized in the production of concrete shall either:

1. Contain no particles retained on a number 4 sieve, or
2. Contain no more than 2% soft particles or 4% soft and chert particles as determined by those particles retained on a number 4 sieve.

3.2 Coarse Aggregate: Coarse aggregate shall meet or exceed the requirement as specified in the current edition of the MDOT Standard Specifications for Construction.

3.3 Dense Graded Aggregates: Dense graded aggregates shall meet or exceed the requirement as specified in the current edition of the MDOT Standard Specifications for Construction.

4. BLOCK (Concrete):

Concrete block for manholes, catch basins, and inlets shall conform to ASTM C-139, with the following exceptions:

- 4.1 Shape: The blocks shall be solid curved blocks with the inside and outside surfaces curved to the required radii. The blocks shall have a groove or other approved type of joint at the ends so that the units interlock to form a strong rigid structure. Curve blocks shall have the inside and outside surfaces parallel.
- 4.2 Size: The nominal dimensions for length and height of the block shall be selected by the producer. The nominal dimension for width (thickness) shall be 6, 8 or 12 inches, as called for on the plans, with a tolerance of ± 3 percent. Where the specified wall thickness on the standard plans is 12 inches, a multiple block wall of two 6-inch wide blocks is permitted. The blocks shall be designed for length so that only full length or half length blocks are required to lay the circular wall of any one course.

Blocks intended for use in the cones or tops of manholes or other structures shall have such shape as may be required to form the structure as shown on the plans with inside and outside joints not to exceed 1/4 inch in thickness.

5. BRICK:

Bricks, when approved for use, shall be concrete conforming to the requirements for concrete building brick of ASTM C-55, Grade S-II.

6. CEMENT AND LIME:

- 6.1 General Requirements: Facilities shall be provided for sampling and inspecting of cement at either the mill, the distribution point, or at the site of the work. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment.

Portland cement shall not develop false set when tested by the mortar method in accordance with ASTM C 359. False set will be considered to have occurred if the penetration is less than 5 mm. at the 5, 8, or 11-minute intervals as defined in the test method. These limits shall apply only in the event of difficulties in placing and finishing the concrete due to premature stiffening.

The Contractor shall furnish the Engineer with a copy of the Certification of Quality of Cement, as provided by the producer.

Ten (10) days may be required from the time of sampling cement before results of tests are reported. The City will not consider claims for delays or demurrage for cement held for test by the Engineer when occasioned by failure to notify the City of source of material.

- 6.2 Testing: Testing will be done in accordance with the ASTM specification applicable to the particular material referred to herein except as otherwise provided in the Operating Procedure for Certifying, Sampling, and Testing Portland Cement as established by the Department or as otherwise specified.
- 6.3 Portland Cement:
- a. Type I, IA, III, and IIIA Cements: These Portland cements shall conform to ASTM C 150. The requirements for Gillmore setting time test and compressive strength through the 28-day test shall apply.

6.4 Masonry Cement: Masonry cement shall conform to ASTM C-91, type N, S and M.

6.5 Hydrated Lime: Hydrated lime shall conform to ASTM C-207, Type S and SA.

7. CONCRETE:

Concrete shall consist of a specified mixture of Portland cement or blended Portland cement fine aggregate, coarse aggregate, water and admixtures when required or permitted, combined in the proportions as specified for the various grades of concrete required. Unless otherwise specified, air-entrained concrete will be required. Where the term "sack" is used in this specification in relation to cement, it shall be interpreted as meaning a 94-pound sack of cement.

MATERIALS:

Cement	Division E	Sec. 6
Coarse Aggregate	Division E	Sec. 3.2
Fine Aggregate	Division E	Sec. 3.1
Water	Division E	Sec. 16
Admixtures	Division E	Sec. 7.2

7.1 Grade and Mix Requirements: The grade of concrete shall be specified by the Engineer and will be called out on the plans and/or the specifications. The grades specified and the mixture requirements shall be in accordance with Concrete Mixture Table as specified on the 1990 edition of the MDOT Standard Specifications For Construction.

CONCRETE MIXTURES TABLE

Grade of Concrete	Section Number Reference (k)	Class of Coarse Aggregate and Relative Quantity (l)	Cement Type (b)(c) Note: (1)=IA (2)=IS-A I(SM)-A (3)=IP-A, I(PM)-A	Cement Content		Fly Ash Lbs./Cu. Yd.	Water-Reducing or Water-Reducing Retarding Admixtures Optional Except Where Required (d)	Consistency (Slump) inches			Anticipated Minimum Strength of Concrete (g)				
				Lbs. per CYD	Sacks (94lb) per CYD			W/out Admixtures or w/Type A or D Admixture(e)	With Type F or G Admixtures		Flexural, psi		Compressive, psi		
									Prior to Addition of Admixtures	After addition of admixtures (f)	At 3 days	At 7 days	At 14 days	At 28 days	At 28 days
45D	4,5,6	6AA	(1), (2), (3)	658	7.0	0	Req'd.	0-3½	0-3	0-7		625	700	725	4500
40S	3	6A, 17A	(1), (2), (3)	611	6.5	0	Opt.	3-5	0-3	3-7		600	650	700	4000
			(1)	545	5.8	92	Req'd.								
35HE	1,2,12	6A	(1), (2)	658	7.0	0	Opt.	0-3	0-3	0-7	550	600		650	3500
			(3)	790	8.4	0	Opt.								
35T	4	6A	(1), (2), (3)	611	6.5	0	Opt.	3-7	0-4	3-8		550	600	650	3500
			(1)	545	5.8	92	Req'd.								
35P, 35S	1(h), 2, 4, 6, 7, 8, 12, 13, 15, 18, 21	6AA (a), 6A, 17A (j)	(1), (2), (3)	564	6.0	0	Opt.	0-3	0-3	0-7		550	600	650	3500
			(1), (2), (3)	526	5.6	0	Req'd.								
			(1)	517	5.5	78	Opt.								
			(1)	480	5.1	72	Req'd.								
30P, 30S	1, 14, 15, 16	6A, 17A(j)	(1), (2), (3)	517	5.5	0	Opt.	0-3	0-3	0-7		500	550	600	3000
			(1), (2), (3)	489	5.2	0	Req'd.								
			(1)	470	5.0	71	Opt.								
			(1)	451	4.8	68	Req'd.								
30M	9, 10, 11, 17, 19, 20, 21	Commercial grade concrete containing 517 pounds (5.5 sacks) of cement per cubic yard. Portland cement may be reduced up to 20 percent by weight when 1.4 pounds of fly ash are substituted for each 1.0 pound of cement removed.													
X		Unless otherwise specified on the plans or in the proposal, Grade X concrete shall have not less than 282 pounds (3.0 sacks) of cement per cubic yard. Portland cement may be reduced up to 20 percent by weight when 1.4 pounds of fly ash are substituted for each 1.0 pound of cement removed.													

Foot Notes to Concrete Mixtures Table:

- (a) Unless otherwise specified, Coarse Aggregate 6AA shall be used for exposed structural concrete used in bridges, retaining walls, and pumphouses.
- (b) Concrete mixtures containing Type IS-A, I(SM)-A, IP-A, or I(PM)-A cement, or containing ground blast-furnace slag or fly ash, shall not be used on Lower Peninsula projects between October 15 and April 1, nor in the Upper Peninsula between October 1 and April 15, except this restriction does not apply to Grade 40S concrete used in foundation piling below ground level, and Grade 35T concrete used in tremie construction.
- © Non-air entraining cement corresponding to the types of air-entraining cement listed may be used with an approved air-entraining admixture to produce the specified air content.
- (d) The quantity of admixture shall be as recommended by the manufacturer; or as directed by the Engineer, to provide reduction in mixing water. The admixture used in Grade 45D concrete shall be a water-reducing or a water-reducing retarding admixture and shall be used in such amounts as necessary to provide the necessary retardation of setting.
- (e) Occasional batches having a consistency outside the specified range may be used if the slump does not exceed the limits of the specified range by more than ½ inch.
- (f) Occasional batches having a consistency outside the specified limits may be used if the slump does not exceed the maximum limits specified by more than 1 inch. This increase in slump shall be due entirely to the addition of the Type F or G admixture.
- (g) The flexural and compressive strengths are not part of the specifications but are listed for informational purposes only and are the minimum strengths anticipated for the mix proportions specified for the various grades of concrete when cured under standard conditions.
- (h) Grade 35S concrete may be used for Miscellaneous Concrete Pavement.
- (i) The mix design basis for bulk volume (dry, loose) or coarse aggregate per unit volume of concrete is 68% for Grade 40S; 70% for Grades 45D, 35S, 35T, and 30S; 72% for Grades 35HE and 35P; and 74% for Grade 30P.
- (j) Coarse aggregate 17A shall not be used in Grade 35P or 30P concrete unless otherwise specified.
- (k) Section Number Reference:
 - 1. Concrete Pavements
 - 2. Concrete Pavement Repairs
 - 3. Foundation Piling
 - 4. Structural Concrete Construction
 - 5. Bridge Railings
 - 6. Bridge Rehabilitation-Concrete
 - 7. Bridge Rehabilitation-Steel
 - 8. Culverts
 - 9. Drainage Structure
 - 10. Slope Protection
 - 11. Paved Ditches
 - 12. Concrete Driveways
 - 13. Concrete Curb and Gutter
 - 14. Bicycle Paths
 - 15. Concrete Sidewalk, Sidewalk Ramps, and Steps
 - 16. Concrete Barriers and Glare Screens
 - 17. Guardrail, Guardrail Anchorages, and Miscellaneous Posts
 - 18. Miscellaneous Precast Concrete Items
 - 19. Rustic Construction
 - 20. Fencing
 - 21. Traffic Signs

7.2 Concrete Admixtures:

7.2.1 Air-Entraining Admixtures: Air-entraining admixtures for concrete shall conform to the requirements of ASTM C-260. Only air-entraining admixtures that appear on the MDOT list of approved admixtures may be used.

7.2.2 Concrete Accelerators: Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to the requirements for Type C or Type E admixtures of ASTM C-494. Only admixtures that appear on the MDOT list of approved admixtures may be used.

Calcium chloride for use in flake or pellet form or on the job preparation of admixture solutions shall conform to the requirements specified for 77% grade of 94% grade calcium chloride of ASTM D-98. The calcium chloride shall not be placed in contact with the cement, but shall be added to the mixing water and thoroughly mixed before the aggregate is added. The cement shall be added last.

7.2.3 Water-Reducing Admixtures and Water-Reducing Retarding Admixtures for Concrete: The water-reducing admixture shall conform to the requirements for Type A and the water-reducing retarding admixtures shall conform to the requirements for Type D of the specifications for chemical admixtures for concrete of ASTM C-494, with the additions stated below. Only the admixtures that appear on the MDOT approved list of admixtures may be used.

Before approval is given for the use of a water-reducing or a water-reducing retarding admixture, the Contractor shall submit evidence based on tests made in a recognized laboratory showing that the material meets the specified requirements.

- a. For admixtures to be used in prestressed concrete, concrete for bridge superstructure, concrete for bridge railings, or concrete containing galvanized steel or aluminum, no calcium chloride shall be added during manufacture and the chloride ion content by analysis shall not exceed 0.5 percent by weight of the admixture.
- b. Type A and Type D admixtures to be used in concrete for other purposes may contain calcium chloride provided that the admixture, when used at the normal dosage, does not contribute more than 0.10 percent chloride ion by weight of cement to the concrete mixture.

7.3 CONCRETE CURING MATERIALS:

7.3.1 Concrete Curing Materials for Pavements:

- a. White Membrane Curing Compound: White membrane curing compound for curing concrete shall conform to the requirements of ASTM C 309, Type 2, Class B Vehicle, with the following additions:
 1. Tests for moisture retention, reflectance, and drying time shall be based on a curing compound application rate of one gallon per 200 square feet of surface.
 2. Three weeks may be required from the time of sampling before results are reported. Compound on hand at the end of a construction season and carried over to the next season shall not be used until resampled and approved.

3. The compound shall be packaged in clean containers. The compound shall be thoroughly agitated to a uniform consistency with the pigment uniformly suspended before transferring the compound between containers and before use.
- b. Transparent Curing Compound for Base Course: Transparent membrane curing compound for curing base course concrete shall conform to the requirements of ASTM C 309, Type 1-D, Class B Vehicle. Testing shall be as specified under Subsections 7.3.1-a-1 and 2.

7.3.2 Concrete Curing Materials for Structures:

- a. Transparent Membrane Curing Compound for Structures: Transparent membrane curing compound for curing structural concrete shall conform to the requirements of ASTM C 309, Type 1, Class B vehicle except that the compound shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from the of the natural concrete. Testing shall be as specified under Subsections 7.3.1-a-1 and 2.
- b. Interim Curing Compound for Bridge Decks: The interim curing compound shall be a white-pigmented, modified, linseed oil based material, either of a water solubilized or an emulsion type and shall meet the requirements for Type 2 compounds of ASTM C 309, with the following exceptions and additions.

Tests for moisture retention will be made at an application rate of one gallon per 150 square feet.

Failure to meet the requirements for reflectance and drying time will not be cause for rejection.

- c. Insulating Blankets: Insulating blankets shall meet the requirements of Federal Specification HH-1-521e, Insulation, Building, Mineral-Wool; Batts, Loose-Fill, and Granular-Fill, Type 1-Batts, Class C, with enveloping membranes.

The thermal conductivity (k) of the insulating blanket shall not exceed 0.27 BTU per hour per square foot for a temperature gradient of one degree F per inch of thickness at mean temperature of 75 F.

The insulating blanket shall be completely enclosed in liners bonded to both sides of the insulating mat.

Insulating blankets shall have either the minimum thickness or the minimum R value specified in the following Table:

INSULATION REQUIREMENTS

Thickness of Pour, Inches	Insulation Requirements, minimum			
	For Unlined Steel Forms		For Wood-Lined Steel or Wood Forms	
	Inches	R Value	Inches	R Value
12 or less	2	7.0	2	5.75
Over 12 to 24	2	7.0	1½	5.75
More than 24	1½	5.25	1	4.0

- d. Polystyrene Insulation: Polystyrene insulation shall be expanded polystyrene cut from preformed material having an average cell diameter of less 1.0 mm. The thermal conductivity (k) of the material shall not exceed 0.27 BTU per hour per square foot for a temperature gradient of one degree F per inch of thickness at mean temperature of 75 F when tested in accordance with ASTM C 177. The material shall also meet the following requirements:

<u>PROPERTY</u>	<u>REQUIREMENTS</u>	<u>ASTM METHOD</u>
Density, lb/cu ft	0.90 min.	C 303
Compressive Strength, psi	9.0 min	D 1621
Flexural Strength, psi	25.0 min	C 203
Water Absorption, % by volume	2.0 max	C 272

- 7.3.3 Burlap: Burlap shall be, at the time of using, in good condition, free of holes, dirt, clay or any other substance which would have a deleterious effect upon concrete. Burlap shall be of such quality that it will absorb water readily when dipped or sprayed and shall weigh not less than 10.8 ounces per square yard when dry and clean.
- 7.3.4 Waterproof Paper: Waterproof paper for curing concrete shall conform to the current ASTM or AASHTO "Specifications for Waterproof Paper for Curing Concrete", Designation C-171 and M-139 respectively.
- 7.3.5 Polyethylene Sheeting: White polyethylene sheeting shall consist of a single sheet having a thickness of not less than 4 mills (.004). Moisture retention shall conform to the requirements of ASTM Specifications Designation C-156, except the Air-Entraining Portland Cement shall be used in the test. The material shall be tested in accordance with the current ASTM Specifications Designation D-882 Method A.

7.4 CONCRETE JOINT MATERIAL:

- 7.4.1 Expansion Joint - Fiber Joint Filler for Concrete Construction: Fiber joint filler shall conform to the requirements of ASTM D 1751. Fiber joint filler shall have such physical characteristics as not to be deformed or broken by ordinary twisting, bending, or handling when exposed to atmospheric conditions.

For concrete pavement, fiber fillers shall be cut rectangular in shape and to a width as shown on the plans. Where holes for load-transfer bars are required, the holes shall be

punched in accordance with the plans. Holes in the filler for concrete pavement repair shall be punched at the site of the repair after the location of load-transfer bars is determined.

7.4.2 Joint Sealants for Concrete Construction:

- a. Hot-poured Joint Sealant: Hot-poured type joint sealant shall conform to the requirements of ASTM C 3405 except that the fine aggregate incorporation into the concrete mixture used to make the bond blocks shall be 2NS sand.

7.5 CONCRETE REINFORCEMENT:

- 7.5.1 Bar Reinforcement for Structures: Bar reinforcement for structures shall be deformed bars meeting the requirements of ASTM A 706 or for Grade 60 steel bars of ASTM A 615, A 616, or A 617, except as follows:

Unless otherwise specified, spiral reinforcement shall meet the requirements for plain or deformed Grade 40 steel bars of ASTM A 615 or A 617 or for cold-drawn wire of ASTM A 82.

Bar reinforcement for prestressed concrete beams meeting the requirements for Grade 40 steel bars of ASTM A 615 or A 617 or Grade 50 steel bars of ASTM A 616 will be permitted.

- a. Bending: Bent bar reinforcement shall be cold shop bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the following requirements. Any field bending shall be done cold as specified herein. Any heat bending will be cause for rejection.

For ordinary bends, the finished bend diameter shall be as specified in the following Table:

Bar Size	Inside Diameter of Bend
Nos. 3 through 8	6 bar diameters
Nos. 9 through 11	8 bar diameters
Nos. 14 and 18	10 bar diameters

For bends in stirrups and ties, the inside diameter shall not be less than 4 bar diameters.

Tolerances in cutting and bending bars are as established in the Standard Practice of the Concrete Reinforcing Institute and Detailing Manual of the American Concrete Institute.

- b. Bundling and Tagging: Bar reinforcement shall be shipped in standard bundles, tagged, and marked in accordance with the CRSI Code of Standard Practice.
- c. Epoxy Coating: Steel reinforcement required to be epoxy coated shall be coated in accordance with the requirements of ASTM D 3963, with the following exceptions and additions:
 - 1. The coating material, in addition to meeting the requirements of ASTM D 3963, shall be selected from one of the products on the MDOT Qualified Products List.

2. The location of tests made by MDOT on samples obtained for determining thickness of coating, adhesion of coating, and holidays may be made either at the coating applicators plant or at the Laboratory. A sufficient quantity of bars over plan quantity shall be coated to permit splicing to replace bars removed for test samples.
 3. The coating applicator shall furnish written certification that the coated reinforcing bars were cleaned, coated, and testing in accordance with the requirements of ASTM D 3963.
 4. Bars may be coated before or after bending except any damage to the coating shall be repaired in accordance with the recommendations of the manufacturer of the epoxy coating.
- d. Bar Chairs and Wire Ties for Epoxy Coated Steel Reinforcement: The bar chairs and wire ties required for placing and fastening the steel reinforcement shall meet the following requirements:

Bar chairs shall be plastic coated wire, epoxy coated wire, or plastic.

*Wire ties shall be plastic coated wire, epoxy coated wire, or molded plastic clips.
Tie-down wires shall be plastic coated.*

7.5.2 Welded Steel Wire Fabric Reinforcement: Welded steel wire fabric for reinforcement of concrete shall conform to ASTM A 185 and shall be fabricated as shown on the plans.

7.5.3 Bar Reinforcement for Pavements:

- a. Dowels and Bar Reinforcement for Curbing, Glare Screen, Concrete Barriers, and Filler Walls: Dowels and bar reinforcement for curbing, glare screen, concrete barriers, and the filler walls between bridge piers shall be deformed steel bars meeting the requirements of ASTM A 706 or for Grades 40, 50, or 60 of ASTM A 615, A 616, or A 617.
- b. Dowel Bars for Transverse Expansion and Contraction Joints: The dowels shall be straight, smooth, round bars conforming to the dimensions shown on the plans. Dowel bars shall have a minimum yield strength of 40,000 psi and a minimum tensile strength of 70,000 psi when tested after being welded to the dowel basket of 70,000 psi when tested after being welded to the dowel basket assembly, when welding is required.

Except for dowel bars for concrete pavement repair, the dowel bars shall be attached to a basket of approved design by welding or some mechanical means such that the dowels will be able to withstand the forces imposed by concrete placement and still maintain alignment.

For expansion joints, the dowel bars shall be fitted with expansion caps as shown on the plans. The material and design of the caps shall meet the approval of the Engineer before they may be used in the work.

For contraction joints, the free end of the dowel bar shall be free of burrs and shall be saw cut or sheared. If sheared, an expansion cap shall be placed on the free end.

Dowel bars for use in both expansion and contraction joints in concrete pavement repair shall be saw cut on both ends.

Dowel bars shall be protected from corrosion by of the following methods:

- c. Coatings for Dowel Bars: The bars shall be coated with one of the rust-inhibiting coatings included on the Department's list of prequalified coatings, with a precoating surface preparation procedure designed for the service, except that dowel bars for concrete pavement repair shall be shop coated on the cylindrical surface with a durable exterior type, rust-inhibitive paint. The coatings are classified as Type A or Type B coatings based on whether or not a bond breaker is required. Bars with Type A coatings do not require an additional bond-breaking coating.

The rust-inhibiting coatings on each Type A or Type B dowel bar shall have an average thickness equal to the average coating thickness on which the prequalification approval was based, within a tolerance of ± 30 percent. In addition, the average coating thickness shall not be less than 0.010 inch on any bar, with individual determinations within a tolerance of ± 0.004 inches of the average. The coating need not be applied to the end faces of the bars and will not be required within 3 inches of the end which will be fixed in the supporting basket by welding or other mechanical means.

To prevent bonding to concrete, Type B coated dowels shall also be coated with a bituminous material meeting the requirements of MC-70, MS-2a, or RC-250, per MDOT specifications. This coating may be applied by the supplier or by the Contractor. The supplier of the bituminous material shall furnish certification that the coating material shall be a minimum of 0.010 inch thick. The sleeve shall be closely wrapped around the dowel bar so that there will be no movement of the sleeve in relation to the bar and no areas in which the sleeve is not in contact with the bar. Lack of contact will be determined by the formation of dimples in the sleeve when tapped lightly with a ball-peen hammer or similar tool. The lap shall be fastened with a folded lock seam or a continuous weld. The sleeve will not be required within 3 inches of the end of the bar which will be fixed in the supporting basket by welding or other mechanical means.

In lieu of placing a sleeve on a carbon steel bar, a solid stainless steel bar may be furnished, provided it meets the other applicable requirements for dowel bars.

The dowels shall be coated with an approved material to prevent bonding prior to incorporation in the concrete.

- d. Devices for Transverse End-of-Pour Joints: Devices for end-of-pour joints shall be steel hook bolts or straight tie bars.

Hook bolts shall meet the requirements for hook bolts for longitudinal bulkhead joints as specified in Subsection 7.6-c.

Straight tie bars shall be No. 5 or larger steel deformed bars, 30 or more inches in length, and shall meet the requirements specified in ASTM A 615, A 616, A 617, or A 706. Straight ties bars shall be epoxy coated in accordance with the requirements specified in Subsection 7.5.1-c, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.

7.6 Lane Ties for Longitudinal Pavement Joints.

- a. Straight Tie Bars: Straight tie bars shall be No. 5 or larger steel deformed bars, 24 or more inches in length, and shall meet the requirements specified in ASTM A615, A 616, A 617, or A 706. The tie bars shall be epoxy coted in accordance with the requirements specified in Subsection 8.05.03-c, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.
- b. Bent Tie Bars for Bulkhead Joints: Bent tie bars shall be No. 5 or larger steel deformed bars 24 or more inches in length as measure around the outside of the bend. The tie bars shall have a yield strength level of not less than 40,000 psi, and shall have sufficient strength, ductility, and workability to withstand being bent to approximately a 90 degree angle, restraightened, and then withstand the pull-out test requirements per MDOT specifications. The tie bars shall be epoxy coated in accordance with the requirements specified in Subsection 7.5.1-c, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.
- c. Hook Bolts for Bulkhead Joints: Hook bolts for bulkhead joints shall consist of two hook bolts mechanically coupled to form a lane-tie assembly as shown on the plans. The lane-tie assembly shall have an ultimate tensile strength of not less than 24,000 pounds. The threaded portion of the hook bolts shall have nominal 3/4 inch-10 UNC threads and a shank diameter not less than 5/8 inch, nominal bar size (where an existing pavement is to be widened and the pavement contains smaller size couplings, the second half of the lane tie shall be a hook bolts of size compatible with the existing coupling.) The lane-tie assembly shall have a means to prevent the threading of the hook bolts beyond the center of the coupling. The minimum embedment length for standard hook bolts on each side of the joint shall be 7-5/8 inches.
- d. Expansion-Anchored Lane Tie Devices for Bulkhead Devices: Expansion-anchored lane-tie devices for longitudinal bulk-head joints must meet Department approval before being used in the work. The Department will maintain a list of approved anchors which have met the minimum requirements for size and resistance to pull-out and slippage. Hook bolts used with expansion anchors shall have a nominal thread size of 3/4 inch or larger, as necessary for the type of anchor used, and a nominal shank diameter of 5/8 inch or larger. The length shall be as necessary to engage the expansion anchor and extend beyond the face of the existing slab for a minimum of 7-5/8 inches.
- e. Other Longitudinal Bulkhead Joint Devices: Bulkhead joint devices other than bent bars, hook bolts, and expansion-anchored devices shall have a nominal shank diameter of at least 5/8 inch and such additional size as necessary to provide for nominal 3/4 inch-10 UNC threads. They shall have sufficient length and such configuration that, when properly installed in concrete, they will withstand a pull-out test of 12,000 pounds without slippage in excess of 1/32 inch. The second half of mechanically coupled devices shall have the same configurations and embedment length as the first half or shall be a hook bolt having the minimum embedment length specified.

- 7.7 Structure Expansion Anchors and Bolts: Expansion anchors for the size bolt required shall be torque-type anchors or self-drilling flush-type anchors, unless otherwise shown on the plans.

Bolts shall be of the size and shape shown on the plans. The steel used in the bolts shall conform to the requirements for low-carbon steel threaded standard fasteners of ASTM A 307, Grade A Bolts.

8. MORTAR:

Masonry mortar shall be composed of one part Portland Cement and 2½ parts of 2NS fine aggregate by volume. Not more than 15% of the volume of the cement of Hydrated Lime may be added to improve workability. Masonry cement may be used only with the approval of the Engineer.

9. MANHOLES, CATCH BASINS AND INLETS:

9.1 Manholes and Grade Adjusting Rings: Unless otherwise specified on the plans, all manholes and grade adjusting rings shall be constructed of precast reinforced concrete manhole sections conforming to the requirements of ASTM C-478 and C-443.

9.2 Catch Basins: Catch basin structures shall be constructed as detailed on the plans.

9.3 Inlet Structures: Inlet structures shall be constructed as detailed on the plans.

10. SEWER PIPES:

10.1 Acrylonitrile-Butadiene-Styrene Sewer Pipe: 8" thru 15" (A.B.S. Truss Sewer Pipe). When A.B.S. Truss Pipe is specified for installation, the pipe shall conform to the specifications of ASTM D-2680. All A.B.S. Truss Sewer Pipe shall provide an elastomeric gasket joint to prevent exfiltration or infiltration and shall conform to the requirements of ASTM D 3212.

10.2 Corrugated Metal Pipe (C.M.P.): All corrugated metal pipe shall be new of first quality and shall be furnished in such lengths as are indicated on the plans. Unless otherwise specified, the pipe shall be of the riveted type, with lap joint construction; shall be true and straight throughout its entire length, and free from all imperfections. Unless otherwise specified, the pipe shall meet all requirements of AASHTO M-36. The type and gauge of galvanized corrugated metal pipe to be furnished shall be as shown on the plans or specified including plain, perforated, bituminous coated, paved, and/or asbestos bonded.

10.3 Concrete Pipe:

10.3.1 Non-reinforced Concrete Pipe: Non-reinforced concrete pipe shall meet the requirements of ASTM C-14.

10.3.2 Reinforced Concrete Pipe: Reinforced concrete sewer pipe shall meet the requirements of ASTM C-76.

10.3.3 Reinforced Concrete Elliptical Pipe: Reinforced concrete elliptical sewer pipe shall meet the requirements of ASTM C-507.

10.3.4 Unless otherwise specified, all concrete pipe joints shall be rubber "O-Ring" gasket joint conforming to the requirements of ASTM C-443.

10.4 Ductile Iron Pipe: Ductile iron pipe shall meet the requirements of AWWA C151 (ANSI A21.51). The minimum pipe thickness shall be Pressure Class 350 per AWWA C150 (ANSI A21.50) for 12" diameter pipe size & smaller and Pressure Class 250 per AWWA C150 (ANSI A21.50) for 14" diameter pipe size and larger. Pipe joints shall be bolted mechanical or push-on rubber gasketed meeting the requirements of AWWA C111 (ANSI A21.11).

All fittings (3"~24") shall meet the requirements of AWWA C153 (ANSI A21.53) Pressure Class 350 or AWWA C110 (ANSI A21.10) Pressure Class 350. All fittings shall be provided with a bolted mechanical or push-on rubber gasketed joint meeting the requirements of AWWA C111 (ANSI A21.11). All fittings shall be constructed of ductile iron.

All pipe and fittings shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4) and be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All nuts, bolts, and washers used on mechanical joint pipe shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.

Sections of restrained joint pipe shall require the main line pipe material to be Ductile Iron Pipe. In locations where Ductile Iron Mechanical Joint Pipe is used, the restrained joint shall be Megalug field installed joint restraint as manufactured by EBAA Iron, Inc., or approved equal and must be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. The MEGA-BOND restraint coating system shall be provided on all casing bodies, wedge assemblies, and related parts. The restrained joint system shall be pressure rated for 350 psi (4"~16") and 250 psi (18"~24") and be rated in accordance with the performance requirements of ANSI/AWWA C111 / A21.11 rubber gasket joints for ductile iron pressure pipe and fittings. In locations where Ductile Iron Push-on Joints pipe is used the appropriate restraining gasket must be used in accordance with the pipe manufacture. Approved restrained joint gaskets are Fast Grip Gasket as manufactured by American Ductile Iron Pipe, Field Lok Gasket as manufactured by U.S. Pipe or approved equal. The use of restrained joint installations does not eliminate or waive the requirement to provide thrust blocks where called for on the plans, specifications or standard details.

- 10.5 Polyvinyl Chloride (PVC) Sewer Pipe: All 4" thru 15" PVC gravity sewer pipe shall conform to the requirements of ASTM D-3034, Type PSM, SDR Max 35, PVC sewer pipe and fittings. All 18" thru 27" PVC gravity sewer pipe shall conform to the requirements of ASTM F-679.

The term PSM is not an abbreviation, but rather an arbitrary designation for products having certain dimensions.

All PVC pipe shall provide an elastomeric gasket joint to prevent exfiltration or infiltration and shall conform to the requirements of ASTM D-3212. The critical sealing dimensions of the bell, spigot, and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances. The elastomeric compound shall comply in all respects with the physical requirements specified in ASTM D-1869, C-361 and C-443. The pipe bell shall consist of an integral wall section with a solid cross section elastomeric gasket factory assembled, securely locked in place to prevent displacement. The gasket shall be the only element depended upon to make the joint flexible and watertight.

- 10.6 Vitrified Clay Pipe: Vitrified clay sewer pipe when approved for installation shall conform to the standards of ASTM C-700 extra strength pipe. Compression joints for vitrified clay pipe and fittings shall conform to ASTM C-425.
- 10.7 Smooth-Lined Corrugated Plastic Pipe: Smooth-lined corrugated plastic pipe when approved for use in storm sewer applications shall conform to the standards of AASHTO M 294 Smooth-Lined Corrugated PE Pipe, Type S, (SLCPP). Use of said pipe shall be in accordance with the 1990 edition of the Michigan Department of transportation Standard Specifications for Construction as revised on 06-04-92, 05-13-92, and 07-10-92.

- 10.8 Force Main Pipe: Sanitary Sewer Force main pipe shall be cement lined ductile iron pipe. Ductile iron pipe shall meet the requirements of AWWA C151 (ANSI A21.51). The minimum pipe thickness shall be Pressure Class 350 per AWWA C150 (ANSI A21.50) for 12" diameter pipe size & smaller. Pipe joints shall be bolted mechanical or push-on rubber gasketed meeting the requirements of AWWA C111 (ANSI A21.11). All pipe shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Pipe shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105.

It is also acceptable to use AWWA C900 PVC water main pressure pipe for sanitary sewer force main pipe. PVC pressure pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D1784. PVC pressure pipe shall provide a hydrostatic design basis (HDB) rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. The outside diameter (OD) of PVC pressure pipe shall conform with the OD dimensions of cast-iron pipe. PVC pressure pipe shall have a dimension ratio of 18 and a minimum pressure class of 150 psi. All pipe shall have an integral wall-thickened bell end designed for joint assembly using a factory installed elastomeric gasket conforming to ASTM F-477, D-3139, & UNI-B-11 to affect the pressure seal. All pipe shall be designed for direct connection into ductile iron pipe and fittings.

All nuts, bolts, and washers used on mechanical joint pipe shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.

Wherever sanitary sewer force mains deflect under other utility lines, stream crossings or be installed in casing pipes, the force main pipe material shall be ductile iron restrained joint pipe. The force main shall be installed equal to water main pipe and be furnished with thrust blocks as required for water mains (see section 10.4). Force mains shall be tested at 150psi for two hours and must meet the pressure and leakage requirements of AWWA C-600.

11. WATER MAIN MATERIALS:

Whenever stated in these specifications, any reference to AWWA Specifications shall mean the latest revision of the specification.

- 11.1 Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: PVC pressure pipe shall meet the requirements of AWWA C900. PVCO pressure pipe shall meet the requirements of AWWA C909. Both PVC and PVCO pressure pipe are permitted in pipe sizes 8" through 12" diameter and must meet ANSI / NSF Standard 61 (Health) and 14 (Performance) standards. All PVC and PVCO pressure pipe shall be stamped NSF-pw. PVC and PVCO pressure pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D1784. PVC pressure pipe shall provide a hydrostatic design basis (HDB) rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. PVCO pressure pipe shall have a starting stock HDB rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. Finished PVCO pressure pipe shall an HDB rating of 7,100 psi per ASTM D1598 and D2837. The outside diameter (OD) of PVC and PVCO pressure pipe shall conform with the OD dimensions of cast-iron pipe. PVC pressure pipe shall have a dimension ratio of 18 and a minimum pressure class of 150 psi. PVCO pressure pipe shall have a minimum pressure class of 150 psi. All pipe shall have an integral wall-thickened bell end designed for joint assembly using a factory installed elastomeric gasket conforming to ASTM F-477, D-3139, & UNI-B-11 to affect the pressure seal. All pipe shall be designed for direct connection into ductile cast iron pipe and fittings.

11.1.1 Polyvinyl Chloride (PVC) Pressure Pipe 14" through 48" diameter: PVC pressure pipe shall meet the requirements of AWWA C905, must meet ANSI / NSF Standard

61 (Health) and 14 (Performance) standards, and shall be stamped NSF-pw. PVC pressure pipe will be permitted in pipe sizes 14" through 48" diameter. PVC pressure pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D1784, providing a hydrostatic design basis rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. The outside diameter (OD) of PVC pressure pipe shall conform with the OD dimensions of cast-iron pipe. The PVC pressure pipe shall have a dimension ratio of 18 and a pressure class of a minimum 235 psi. Pipe shall have an integral wall-thickened bell end designed for joint assembly using a factory installed elastomeric gasket conforming to ASTM F-477, D-3139, & UNI-B-11 to affect the pressure seal. Pipe shall be designed for direct connection into ductile cast iron pipe and fittings.

- 11.2 Ductile Iron Pipe: Ductile iron pipe shall meet the requirements of AWWA C151 (ANSI A21.51). The minimum pipe thickness shall be Pressure Class 350 per AWWA C150 (ANSI A21.50) for 12" diameter pipe size & smaller and Pressure Class 250 per AWWA C150 (ANSI A21.50) for 14" diameter pipe size and larger. Pipe joints shall be bolted mechanical or push-on rubber gasketed meeting the requirements of AWWA C111 (ANSI A21.11). All pipe shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Pipe shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All nuts, bolts, and washers used on mechanical joint pipe shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.
- 11.3 Prestressed Concrete Pressure Pipe: Prestressed concrete pressure pipe shall meet the requirements of the revision of AWWA C301. The pipe shall be designed for a sustained internal pressure of 150 psi.
- 11.4 Detectable Tracer Tape / Wire: This tape shall be installed for positive pipe locations by pipe/cable locators and a visible warning to excavators on PVC & PVC pipe only. Install 24-inches above the water main pipe. The detection tape shall be not less than 2-inches wide; shall be inert, bonded layer plastic with a metalized foil core. The tape shall be colored blue per the APWA Uniform Color Code with minimum 1-1/4" high lettering warning of buried water line repeated at least every 24-inches. A detectable tracing wire shall be installed with all PVC & PVC pipe at the pipe spring line. The wire shall be #12 Copper-Clad Steel (CCS) High Strength Soft Drawn 380# tracer wire as manufactured by Copperweld. Splices or connecting two wires shall utilize solder, crimp connections, split bolt connectors, greased wire nut or silicon filled wire nut as recommended by the manufacturer.
- 11.5 Fire Hydrants: Fire hydrants shall be East Jordan Iron Works 5BR-250 or Mueller 5-1/4" Super Centurion 250 having the following features: a 5-1/4" valve opening, 6" mechanical joint inlet as per ANSI A21.11, two (2) each 2-1/2" hose nozzles, one (1) 4-1/2" pumper nozzle, 1-1/2" pentagon shaped operating nuts for installation in a 5' 6" trench, open left, breakable flange and bolts, and factory painted yellow above grade and black below. All hose and pumper nozzles shall be national standard threaded. All hydrants shall be furnished with the drainage hole factory plugged. Dry-barrel fire hydrants shall meet the requirements of AWWA C502. All hydrants are to be supplied with nuts, bolts and washers being #304 stainless steel (above and below grade). Each hydrant shall be wrapped with a polyethylene encasement below grade. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All joints including the hydrant tee shall be restrained joints.
- 11.6 Resilient Seated and Resilient Wedge Gate Valves (3"-12"): Resilient seated gate valves shall have the following features: ductile or cast iron body, bronze mounted, non-rising

stem, rubber-covered gate, open left, design operating pressure 250 psi, 2" operating nut, and mechanical joint ends as per AWWA C111 (ANSI 21.11). Gate valves shall not be used in water mains with diameters larger than 30 inches. All resilient seated gate valves shall meet the requirements of AWWA C509 in cast iron or ductile iron construction or AWWA C515 ductile iron construction. Acceptable manufacturers for applicable C509 and C515 Resilient Wedge Valves in these sizes are: EJW, American Flow Control, Mueller, Clow, Kennedy, or as approved. All valve body internal and external surfaces and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly. All nuts, washers, and bolts shall be #304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105.

- 11.6.1 Resilient Wedge Valves (14" to 36"): When permitted on the plans, valves 14" to 30" shall be resilient wedge type rated for 250 psi cold water working pressure. Valve body, bonnet, wedge and operating nut shall be constructed of ductile iron meeting AWWA C515. The exterior of the ductile iron wedge shall be fully encapsulated with rubber. The wedge shall be symmetrical and seal equally in either direction. The 2" operating nut shall be constructed of ductile iron and have four (4) flats at the stem connection to assure even input torque to the stem. All gaskets to be pressure energized O-ring. Stem shall be sealed by three O-rings. The top two O-rings shall be replaceable with the valve fully open and while subject to full rated working pressure. Valves shall have thrust washers located with one above and one below the thrust collar to assure trouble free operation of the valve. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly. All nuts, washers and bolts are to be #304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105. Acceptable manufacturers for C515 Resilient Wedge Valves in these sizes are: American Flow Control, Kennedy, or as approved.
- 11.7 Rubber-Seated Butterfly Valves (16" & larger): Butterfly valves shall be Kennedy Valve Manufacturing Company Style 4500 or Pratt Model "Ground Hog" having the following features: ductile-iron body, rubber-seated, open left, mechanical joint ends as per AWWA C111 (ANSI A21.11) and 2" square operating nut. All butterfly valves shall meet the requirements of AWWA C504, Class 150B. All valves used in 16" or larger diameter pipe shall be butterfly valves, unless specified. Equivalent butterfly valves may be accepted upon written approval of the City Engineer before Bid closing date. All valve body internal and external surfaces and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly and all nuts, washers, and bolts are to be #304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105.
- 11.8 Hydrant Valves: Hydrant valves shall be of the same specifications as resilient seated or resilient wedge gate valves as specified in Section 11.6. All hydrant valves shall be 6" in size.
- 11.9 Valve Boxes: Valves boxes shall be Tyler Pipe Series 6860 Box D having the following features: constructed of cast iron, three (3) pieced, 5-1/4" shaft, screw type adjustment, adjustable 45" - 66" extension range, and complete with a lid marked "WATER" in raised letters. Valve boxes shall be furnished with a #6 round base for 12" and smaller valves and a #8 round base or equivalent for 12" - 16" valves. Valve box base for valves larger than 16" shall be as approved by the Engineer. Approved equals are the Bibby-Ste-Croix D valve box and EJW 8560 valve box D with a #6 base.

- 11.10 Fittings-Sizes 3" Through 24": All fittings shall meet the requirements of AWWA C153 (ANSI A21.53) Pressure Class 350 or AWWA C110 (ANSI A21.10) Pressure Class 350. All fittings shall be provided with a bolted mechanical or push-on rubber gasketed joint meeting the requirements of AWWA C111 (ANSI A21.11). All fittings shall be constructed of ductile iron. Fittings shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Also fittings shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All mechanical joint fitting bolts, nuts, and washers shall be supplied with #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.
- 11.11 Fittings-Sizes 30" Through 64": All fittings shall meet the requirements of AWWA C110 (ANSI A21.10) Pressure Class 250. All fittings shall be provided with a bolted mechanical or push-on rubber gasket joint meeting the requirements of AWWA C111 (ANSI A21.11). All fittings shall be constructed of ductile iron. Fittings may be constructed of gray iron when ductile iron is not available. Fittings shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Also fittings shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All mechanical joint fitting bolts, nuts, and washers shall be supplied with #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.
- 11.12 Tapping Sleeves: Water main tapping sleeves shall be #304 stainless steel including the flange. The shell, lift bar, and flange shall be stainless steel. The flange gasket shall be factory installed virgin SBR compound or equal for water mains. The tapping sleeve shall be provided with a stainless steel 3/4" NPT test plug for pressure testing the sleeve prior to tapping the main. The tapping sleeve and valve shall be installed and pressure tested at 90 lbs for 5 minutes with no loss to be approved to proceed with tapping the main. The test shall be witnessed by Water Department personnel. The tapping sleeve and valve shall be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. Tapping sleeves shall be Romac Industries, Inc., "SST", Power Seal Pipeline Products Corp. Model 3490, or approved equal. Special tapping sleeves for tapping concrete cylinder pipe shall be Romac Industries, Inc., "FTS 435" steel fabricated tapping sleeve with stainless steel (#304 minimum) straps and fusion bonded epoxy coating per AWWA C213 or approved equal. All bolts, nuts, and washers shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal. Approved equal tapping sleeves shall be subject to submittal of manufacturer specifications, approval of the Engineer and issuance of contract addendum prior to the bid due date.
- 11.13 Couplings: Water main couplings required for straight, transition, reductions, cut-in and end caps shall be ductile iron sleeve, flanges, and end caps. The gaskets shall be a rubber compound suitable for water mains. All bolts, nuts, and washers shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal. All couplings shall be furnished with a shopcoat enamel finish and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. Couplings shall be Smith-Blair Omni Coupling System, Dresser Coupling Style 253, Power Seal Pipeline Products transition Coupling System, Hymax Coupling Series, or approved equal.
- 11.14 Restrained Joints: Wherever called out on the plans, sections of restrained joint pipe shall require the main line pipe material to be Ductile Iron Pipe. In locations where Ductile Iron

Mechanical Joint Pipe is used, the restrained joint shall be Megalug field installed joint restraint as manufactured by EBAA Iron, Inc. and must be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. The MEGA-BOND restraint coating system shall be provided on all casing bodies, wedge assemblies, and related parts. The restrained joint system shall be pressure rated for 350 psi (4"~16") and 250 psi (18"~24") and be rated in accordance with the performance requirements of ANSI/AWWA C111 / A21.11 rubber gasket joints for ductile iron pressure pipe and fittings. In locations where Ductile Iron Push-on Joints pipe is used the appropriate restraining gasket must be used in accordance with the pipe manufacture. Approved restrained joint gaskets are Fast Grip Gasket as manufactured by American Ductile Iron Pipe, Field Lok Gasket as manufactured by U.S. Pipe or approved equal. The use of restrained joints on water main installations does not eliminate or waive the requirement to provide thrust blocks where called for on the plans, specifications or standard details.

- 11.15 Bolts, Nuts, & Washers: All bolts, nuts, and washers used by a manufacturer to fabricate and assemble water main fire hydrants, resilient seat/wedge valves, and butterfly valves shall be #304 stainless steel.

All bolts, nuts, and washers used for the installation of water main tapping sleeves, couplings, and mechanical joint fittings shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.

- 11.16 Casing Pipe Spacers: All pipe inserted into casing pipes shall have casing spacers strapped to the pipe in accordance with the manufacturer specifications. Casing spacers shall: Have a body of either Stainless Steel or Ductile Iron and runners made of Ultra High Molecular Weight Polymer Plastic as manufactured by Advanced Product Systems or approved equal or be a Raci - High Density Polyethylene (HDPE) body and runner as manufactured by the Public Works Marketing, Inc. or approved equal.

12. MANHOLE STEPS:

- 12.1 Aluminum manhole steps shall be fabricated of aluminum alloy conforming to Federal Specification QQ-A-200/8 having a minimum tensile strength of 38,000 psi and a minimum yield strength of 35,000 psi. Elongation shall not be less than 10% in 2 inches and each step shall be capable of carrying a load in the center of the cross bar of 1,500 lbs. when projected 4 inches from the wall without permanent deformation. Steps shall have a tread 10 inches in width and a minimum 2-inch vertical hook on the ends embedded in concrete.
- 12.2 Plastic coated steel steps shall be fabricated of co-polymer polypropylene with ½" minimum deformed reinforcing rod. The step shall meet the requirements of ASTM 2146 under Type II, Grade 16906. The steel material shall be grade 60 and conform to the requirements of ASTM A-615.

13. MANHOLE, CATCH BASIN, INLET FRAMES AND COVERS: Manhole, catch basin, inlet frames and covers shall be supplied as specified in the plans.

14. STRUCTURAL STEEL: Structural steel shall meet the specifications of AISC and shall be fabricated as specified in the plans.

15. LANDSCAPING MATERIAL:

- 15.1 Topsoil: Topsoil shall be dark loam containing a sufficient amount of organic matter free from grasses, weed roots, inorganic material, and subject to the approval of the engineer.

- 15.2 Sod: Sod shall be nursery grown turf, densely rooted bluegrass free from weeds (Class A).
- 15.3 Seed: Seed shall conform to the following:
- a. Class A shall be 30% Perennial Rye, 30% Kentucky Blue, and 40% Creeping Red Fescue.
 - b. Class B shall be 50% Perennial Rye, 15% Kentucky Blue, and 35% Creeping Red Fescue.
 - c. No seed will be accepted with the date of test of more than six months prior to the date of sowing.
 - d. Certification of the seed mixture analysis and net weight must be provided to the Engineer.
- 15.4 Fertilizer: Chemical fertilizer shall be a ready-mixed granular material containing equal amount (12-12-12) by weight of available Nitrogen (N), readily available Phosphoric Acid (P_2O_5) and total available Potash (K_2O) mixed with not less than 40% by weight of filler. Certification of analysis and net weight must be supplied to the Engineer.
- 15.5 Trees: Trees shall be 4-inch diameter, nursery grown and shall qualify under the Horticultural Standards ASA:Z60.1 and shall be of the species specified on the plans or specifications.
- 15.6 Mulch: Mulch shall be clean wheat or oat straw chopped to a maximum length of three (3) inches, applied at the rate of 100 lbs. per 1000 square feet (2 tons per acre).
- 15.7 Latex Base Adhesive for Mulching: Latex base adhesive shall be 48% styrene, 50% Butadiene, and 2% additive; 42.0 to 46.0% solids and a PH, as shipped, of 8.5 to 10.0.
16. WATER: The water used in concrete shall be clean, clear and free from injurious quantities of oil, acid, alkali, vegetable, organic or other matter. If the water is of questionable quality, it shall be tested in accordance with the "Standard Methods of Test of Quality of Water to be Used in Concrete" of the AASHTO Designation T-26 and subsequent revisions.
- Contractor desiring to use water from the City water mains, whether from public hydrants or otherwise, will be required to make application to the City of Monroe Water Department and to conform to the rules and regulations provided in such cases by City Ordinance and Rules of Department.
17. CASING PIPE: Steel case pipe shall be used for construction at railroad or highway crossings as shown on the drawings or as specified. Steel casing pipe shall comply with the following minimum requirements or such minimum requirements as established by the authority having jurisdiction. Casing pipes at other locations shall also comply with the following minimum requirements unless otherwise indicated.

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE		
<u>NOMINAL THICKNESS - INCHES</u>		
COATED OR CATHODICALLY PROTECTED	UNCOATED AND UNPROTECTED	NOMINAL DIAMETER INCHES
0.188	0.251	Under 14
0.219	0.282	14 & 16
0.250	0.313	18
0.281	0.344	20
0.312	0.375	22
0.344	0.407	24
0.375	0.438	26
0.406	0.469	28 & 30
0.438	0.501	32
0.469	0.532	34 & 36
0.500	0.563	38, 40 & 42
0.563	0.626	48
0.625	0.688	54

Smooth wall steel pipes with a nominal diameter of over 54 inches will not be permitted.

Steel pipe shall have a minimum yield strength of 35,000 psi. All joints shall be fully welded completely around the circumference of the pipe. Welds shall be ground smooth inside and out to prevent conflict with the soil or pipe placement. If coated pipe is used, the coating shall be repaired following welding.

18. **CONTROL DENSITY BACKFILL:** Control density backfill shall consist of a mixture of fly ash (as delivered from coal fired power plants meeting ASTM C-618 for fineness), Type I cement (ASTM C-150), treated water that is nondeleterious to the control density backfill and salvaged materials. The control density backfill shall have a minimum density of 134 pounds per cubic foot, have a minimum compressive strength of 50 psi and a maximum compressive strength of 100 psi. Control density backfill shall be "K-Krete" as provided by K-Krete, Inc., and Kuhlman Corporation, Toledo Ohio, or "Stabilized Backfill Mix" as provided by Messina Concrete, Monroe, Michigan or approved equal prior to bidding. Placement of the material must be in accordance with the manufacturer's specifications.