

CATEGORY 900 MATERIALS

SECTION 900 – GENERAL REQUIREMENTS

900.01 GENERAL. All materials included in this Category will be sampled, tested and inspected as specified in the most recently published cited standards. The specification limits for each material are established and no deviation from these limits will be permitted except when, in the judgment of the Engineer, the deviation will not be detrimental to the work. In such cases, refer to the appropriate specification governing price adjustments for non-conformance.

Within 30 days after receipt of notification of award of the Contract, the Contractor shall submit in writing, to the Engineer, the sources from which the Contractor proposes to obtain all materials to be incorporated into the project. No material shall be introduced into the work until approval of sources has been obtained. The County reserves the right to completely or partially test any material for specification compliance.

Sampling shall conform to the State Highway Administration's Sample Testing and Frequency Guide unless otherwise directed by the Engineer. All source approvals are made subject to continuing production of materials conforming to these Specifications. Material sources may be rejected where it is evident that the material tends to be of marginal quality when compared to the specification limits in any of its specified properties.

SECTION 901 – AGGREGATES

901.01 This section covers the material details, quality requirements and test methods applicable to aggregates. Grading requirements are outlined in Tables 901 A and 901 C; physical properties are outlined in Tables 901 B and 901 D. Force drying may be used in the preparation of samples for grading tests conducted in the field. Quarries providing material to Baltimore County projects must be listed in the current MdSHA Aggregate Bulletin and approved by Baltimore County DPW&T's Division of Construction Contracts Administration.

TABLE 901 A

AGGREGATE GRADING REQUIREMENTS - TEST METHOD T 27

MATERIAL		U.S. STANDARD SIEVE SIZE - PERCENT PASSING																
		3"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 10	No. 16	No. 30	No. 40	No. 50	No. 100	No. 200
2" - 3" STONE for SED. CTRL (j)		100	25-60	-	0-15	-	0-5	-	-	-	-	-	-	-	-	-	-	-
CRUSHER RUN AGGREGATE CR-1		100	-	-	-	45-70	-	-	-	15-45	-	-	-	-	-	-	-	0-10
CRUSHER RUN AGGREGATE CR-6		-	-	100	90-100	-	60-90	-	-	30-60	-	-	-	-	-	-	-	0-15
BANK RUN GRAVEL- SUBBASE		-	100	-	-	90-100	-	60-100	-	-	-	35-90	-	-	20-55	-	-	5-25
GRADED AGGREGATE-																		
BASE DESIGN RANGE (a)(h)		-	-	100	95-100	-	70-92	-	50-70	35-55	-	-	-	12-25	-	-	-	0-8 (i)
TOLERANCE (b)		-	-	-2	± 5	-	± 8	-	± 8	± 8	-	-	-	± 5	-	-	-	± 3 (c)
BANK RUN GRAVEL - BASE		-	100	-	-	85-100	-	60-100	-	-	-	35-75	-	-	20-50	-	-	3-20
COARSE AGGREGATE (FOR PORTLAND CEMENT CONCRETE)	57 & UNDERDRAIN	-	-	-	100	95-100	-	25-60	-	0-10	0-5	-	-	-	-	-	-	-
	67	-	-	-	-	100	90-100	-	20-55	0-10	0-5	-	-	-	-	-	-	-
	7	-	-	-	-	-	100	90-100	40-70	0-15	0-5	-	-	-	-	-	-	-
FINE AGGREGATE (FOR PORTLAND CEMENT CONCRETE & UNDERDRAIN) (d)		-	-	-	-	-	-	-	100	95-100	-	-	45-85	-	-	5-30	0-10	-
COARSE AGGREGATE (FOR LIGHTWEIGHT PORTLAND CEMENT CONCRETE)		-	-	-	-	100	90-100	-	10-50	0-15	-	-	-	-	-	-	-	-
FINE AGGREGATE (FOR LIGHTWEIGHT PORTLAND CEMENT CONCRETE) (d)		-	-	-	-	-	-	-	100	85-100	-	-	40-80	-	-	10-35	5-25	-
FINE AGGREGATE/ SAND MORTAR and EPOXIES (d)		-	-	-	-	-	-	-	-	100	95-100	-	-	-	-	-	0-25	0-10
MINERAL FILLER		-	-	-	-	-	-	-	-	-	-	-	100	-	95-100	-	-	70-100

(a) To establish target values for design.

(b) Production tolerance.

(c) ± 2 for field grading. (omitting T 11)(d) Fine aggregate includes natural or manufactured sand. *For underdrain, use bank run sand only.*

(e) Reserved.

(f) Reserved.

(g) 3" Screen

(h) Graded Aggregate Base shall conform to ASTM D2940.

Unless otherwise specified, the gradation design range shall control and the limit for material finer than 0.02 mm is waived.

(i) 8.0 max.

(j) AASHTO M43 No. 1 Modified ($d_{60}=2.5"$, $d_{100}= 3"$)

TABLE 901 B

AGGREGATE PHYSICAL PROPERTY REQUIREMENTS

MATERIAL	TEST METHOD										
	S P E C I F I C A T I O N	T 90	T 104	T 112	T 113	T 112 and T 113	T 11	T 113	D 4791 (a)	T 96	T 21
		PI	SODIUM SULFATE SOUND- NESS	CLAY LUMPS & FRIABLE PARTICLES	CHERT; LESS THAN 2.40 Sp. Gr.	SUM OF CLAY, LUMPS, FRIABLE PARTICLES & CHERT	MATERIAL FINER THAN No. 200 SIEVE	COAL & LIGNITE	FLAT and ELON- GATED	LOS ANGELES ABRASION	ORGANIC IMPURITIES
max	%max	%max	%max	%max	%max	%max	%max	%max	%max	max	
CRUSHER RUN AGGREGATE CR-6	D2940 (h)	6	12	-	-	-	-	-	15	50	-
BANK RUN GRAVEL- SUBBASE	D 2940	9	12	-	-	-	-	-	-	50	-
GRADED AGGREGATE - BASE	D 2940	6	12	-	-	-	-	-	15	50	-
BANK RUN GRAVEL - BASE	D 2940	9	12	-	-	-	-	-	-	50	-
COARSE AGGREGATE - PCC (b)	M 80 Class A	-	12	2.0	3.0	3.0	1.0 (c)	0.5	12	50	-
FINE AGGREGATE - PCC (b) (d)	M 6 Class B	-	10	3.0	-	-	4.0 (e)	1.0	-	-	3.0
COARSE AGGREGATE - LIGHTWEIGHT PCC	M 195	-	-	2.0	-	-	-	-	12	-	-
FINE AGGREGATE - LIGHTWEIGHT PCC (f)	M 195	-	-	2.0	-	-	-	-	-	-	3.0
FINE AGGREGATE / SAND MORTAR and EPOXIES	M 45	-	10	1.0	-	-	-	0.5	-	-	3.0
MINERAL FILLER (g)	M 17	NP	-	-	-	-	-	-	-	-	-
CRUSHED GLASS	M 80	-	12	-	-	-	-	-	-	45	-

(a) Dimensional ratio of calipers shall be 5:1.

(b) Test coarse and fine aggregate for PCC for alkali silica reactivity (ASR) per [MdSHA MSMT 212](#).

(c) 1.5 if material passing No. 200 sieve is dust of fracture, free of clay or shale.

(d) In areas exposed to traffic, manufactured sand shall have a minimum ultimate polish value of 8, based on the parent rock.

(e) 5.0 for concrete not subject to surface abrasion.

(f) Fine aggregate meeting M 6 may be used if the lightweight concrete does not exceed the maximum unit weight specified in the Contract Documents.

(g) Fly ash shall not exceed 12 percent loss on ignition.

(h) Other approved inert materials of similar characteristics may be used provided they meet these provisions. When crushed reclaimed concrete is used, the soundness loss by 5 cycles of the magnesium sulfate test shall not exceed 18 percent when tested as specified in T 104.

TABLE 901 C
ASPHALT MIXES

AGGREGATE GRADING REQUIREMENTS, PERCENT PASSING FOR MIX DESIGN, TEST METHOD T 27

MATERIAL		SIEVE SIZE									
		19.0 mm	12.5 mm	9.5 mm	4.75 mm	2.36 mm	1.18 mm	600 μ m	300 μ m	150 μ m	75 μ m
HOT MIX ASPHALT SUPERPAVE - 4.75 mm		-	-	100	80-100	36-76	-	-	-	-	2-12
GAP GRADED HOT MIX ASPHALT - 9.5 mm		100	100	75-90	30-50	20-30	-	-	-	-	8-13
GAP GRADED HOT MIX ASPHALT - 12.5 mm		100	90-99	70-85	28-40	18-30	-	-	-	-	8-11
GAP GRADED HOT MIX ASPHALT - 19.0 mm		100	82-88	60 max.	22-30	14-20	-	-	-	-	9-11

MATERIAL		SIEVE SIZE									
		3/4 in.	1/2 in.	3/8 in.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
SLURRY SEAL (SS) AND LATEX MODIFIED SLURRY SEAL (LMSS)	MIX II	-	-	100	90-100	65-90	45-70	30-50	18-30	10-21	5-15
	MIX III	-	-	100	70-95	45-70	28-50	19-34	12-25	7-18	5-15
CHIP SEAL SURFACE TREATMENT	7	100	90-100	40-70	0-15	0-5	-	-	-	-	-
	8	-	100	85-100	10-30	0-10	0-5	-	-	-	-

Note: HMA Superpave 4.75 mm shall be designed with ESAL ranges of 0.3 to less than 3.0 million.

See AASHTO M 323 for dense-graded asphalt grading requirements

901.01.01 Steel Slag. Steel slag may be used for chip seal surface treatment, but not for any other aggregate.

TABLE 901 D
AGGREGATE PHYSICAL PROPERTY REQUIREMENTS FOR ASPHALT MIXES

MATERIAL	TEST METHOD											
	SPECIFICATION	T 90	T 104	T 112	T 113	T 112 and T 113	T 11	T 113	D 4791 (a)	T 96	MSMT 411	T 279
		PI	SODIUM SULFATE SOUNDNESS	CLAY LUMPS & FRIABLE PARTICLES	CHERT; LESS THAN 2.40 Sp. Gr.	SUM OF CLAY, LUMPS, FRIABLE PARTICLES & CHERT	MATERIAL FINER THAN No. 200 SIEVE	COAL & LIGNITE	FLAT and ELONGATED (h)	LOS ANGELES ABRASION (LA)	PV (c)	BPN (c)
	max	%max	%max	%max	%max	%max	%max	%max	%max	min	min	
HOT MIX ASPHALT SUPERPAVE 4.75 mm	M 323	NP	12	2.0	3.0	3.0	-	0.5	10	45	5 (b)	-
HOT MIX ASPHALT SUPERPAVE - 9.5, 12.5, and 19.0 HIGH ESAL	M 323	NP	12	2.0	3.0	3.0	-	0.5	10	45	5 (b)	-
HOT MIX ASPHALT SUPERPAVE - 9.5, 12.5, and 19.0 LOW ESAL	M 323	NP	12	2.0	3.0	3.0	-	0.5	10	45	5 (b)	-
HOT MIX ASPHALT SUPERPAVE - 9.5, 12.5, and 19.0 mm 8PV	M 323	NP	12	2.0	3.0	3.0	-	0.5	10	45	8 (e)	-
HOT MIX ASPHALT SUPERPAVE - 25.0 and 37.5 mm	M 323	NP	12	2.0	3.0	3.0	-	0.5	10	45	-	-
GAP GRADED HOT MIX ASPHALT SUPERPAVE-9.5, 12.5, and 19.0 mm	M 323	NP	12	2.0	3.0	3.0	-	0.5	20/5 (g)(i)	30	8 (e)	-
SLURRY SEAL (SS) and LATEX MODIFIED SLURRY SEAL (LMSS)	-	NP	12	-	-	-	-	-	-	-	4 (f)	16
CHIP SEAL SURFACE TREATMENT	M 80, CLASS A	-	-	2.0	3.0	3.0	1.0 (d)	0.5	-	45	-	-
CRUSHED GLASS	M 80	-	12	-	-	-	-	-	-	45	-	-

(a) Dimensional ratio of calipers shall be 5:1.

(b) Polish Value (PV) shall be 5.5 when any aggregate being blended has a PV less than 5.0. PV shall be 5.0 when the aggregate from each source has a PV 5.0 or greater. Aggregate from more than two sources may be blended. Determine proportions of blended aggregate under MSMT 416. Not applicable for Gap Graded surface mixes or any other surface mix requiring high polish aggregate.

(c) PV and British Pendulum Number (BPN) determined on parent rock. When recycled asphalt pavement (RAP) is used the PV shall be 4.

(d) 1.0 for samples taken at the point of production. Samples taken at any point after shipment shall not have more than 1.5 percent finer than No. 200 sieve.

(e) PV shall be 9 when any aggregate being blended has a PV less than 8. PV shall be 8 when the aggregates from each source has a PV of 8 or greater. When carbonate rock is used, it shall have a minimum of 25 percent insoluble residue retained on the No. 200 sieve.

(f) No blending allowed.

(g) Dimensional ratio of calipers shall be 3:1/5:1.

(h) The test for flat and elongated particles (max/min) shall be conducted on the blend.

(i) Test conducted on particles retained in the No. 4 sieve.

901.02 STONE FOR RIPRAP, CHANNELS, DITCHES, SLOPES, AND GABIONS.

The stone shall be field or quarry stone of approved quality and may be certified from a source previously approved. Except as indicated elsewhere in these Specifications, maximum dimension of stone shall not exceed four (4) times the minimum dimension.

901.02.01 Stone for Riprap.

(a) Riprap for erosion and sediment control and slope reinforcement applications (exclusive of work in MdSHA rights-of-way).

1. Riprap shall be in accordance with the requirements given in Maryland Standards and Specifications for Erosion and Sediment Control (MSSESC), latest edition.
2. The stone for riprap shall be field stone or rough and hewn quarry stone of approved quality and may be certified from a source previously approved by Baltimore County DPW&T's Division of Construction Contracts Administration for this use. The stone must be hard and angular (not limited to a maximum dimension less than or equal to four times the minimum dimension) and of a quality that will not disintegrate with exposure to water or weathering. The specific gravity of the individual stones is to be at least 2.5. Recycled concrete equivalent may be used provided it has a density of at least 150 pounds per cubic foot and does not have any exposed steel or reinforcing bars.
3. Riprap must be composed of a well graded mixture of stone sized so that fifty (50) percent of the pieces, by weight, are larger than the size determined by the Engineer. A well graded mixture, as used herein, is defined as a mixture composed primarily of larger stone sizes but with a sufficient mixture of other sizes to fill the smaller voids between the stones. The diameter of the largest stone in such a mixture must not exceed the respective d_{100} selected from the table in Section 901.02.01(a), item 4 below. The d_{50} refers to the median diameter of the stone. This is the size for which 50 percent, by weight, will be smaller and 50 percent will be larger.
- 4.

Riprap Sizes and Thickness

Class	d_{50}	d_{100}	Thickness (T)
I	9.5 inches	15 inches	19 inches
II	16 inches	24 inches	32 inches
III	23 inches	34 inches	46 inches

(b) Riprap used in MdSHA rights-of-way.

1. Riprap shall be in accordance with the requirements provided by MdSHA except as modified by these Specifications.
2. Stone for riprap shall be uniformly graded from the smallest to the largest pieces as specified in the Contract Documents. The stone will be accepted upon visual inspection at the point of usage, and shall conform to the following:

CLASS OF RIPRAP	SIZE	PERCENT OF TOTAL By weight
0	Heavier than 33lb.	0
	Heavier than 10 lb.	50
	Less than 1 lb.	10 max
I	Heavier than 150lb.	0
	Heavier than 40 lb.	50
	Less than 2 lb.	10 max
II	Heavier than 700lb.	0
	Heavier than 200lb.	50
	Less than 20 lb.	10 max
III	Heavier than 2000lb.	0
	Heavier than 600 lb.	50
	Less than 40 lb.	10 max

Note: Optimum gradation is 50 percent of the stone being above and 50 percent below the midsize. Reasonable visual tolerances will apply.

901.03 STONE FOR CHANNELS AND DITCHES. Stone for channels and ditches shall conform to the size requirements of Class I Riprap given in Section 901.02.01(a), item 4, and the following:

QUALITY REQUIREMENTS	
TEST AND METHOD	SPECIFICATION LIMITS
Apparent Specific Gravity T 85, min.	2.50
Absorption T 85, % max.	3.0
Sodium Sulfate Soundness 5 cycles, 2 ½ - 1 ½ in. Aggregate T 104 % loss max.	20

901.04 STONE FOR SLOPES. Stone for slopes shall conform to M 43, size number 1 omitting T 11. The stone shall also conform to the quality requirements specified in Section 901.03.

901.05 STONE FOR GABIONS. Stone for gabions shall conform to the quality requirements specified in Section 901.03 and the following, except that the loss by sodium sulfate shall not be greater than 12 percent.

DEPTH OF BASKET In.	SIZE OF INDIVIDUAL PIECES In.
6	3 – 6
9	4 – 7
12	4 – 7
18	4 – 7
36	4 – 12

Size of pieces will be determined visually.

901.06 RECYCLED CONCRETE FOR AGGREGATE.

901.06.01 Description. Recycled concrete of equivalent gradation may be used as a substitute for natural stone aggregate with the approval of the Engineer. Its use shall be limited to applications that will NOT be exposed to public view.

901.06.02 Materials. Recycled concrete shall meet gradation requirements per Table 901 A for the aggregate as specified. The recycled aggregate shall be noted as RC-1, RC-6, RC-57, etc. where the gradation is equivalent to natural stone aggregate CR-1, CR-6, No. 57, etc. respectively.

Recycled concrete aggregate shall be free of contaminants including, but not limited to, paper, scrap wood, metal including rebar, soil, vegetation, organic content, excessive amount of brick, glass, plastic, petroleum derivatives and other trash. Recycled concrete aggregate shall not contain more than 5 percent brick and/or hot mix asphalt by mass except when used as common borrow. Recycled concrete aggregate shall meet the physical properties requirements of Table 901 B for the equivalent gradation of the recycled concrete to be used.

Environmental testing and Certification shall not preclude the normal materials acceptance process, and the recycled material shall meet all applicable specifications. The Contractor shall submit a copy of all EPA regulations governing use of the recycled materials as well as certified test results and material safety data sheets along with the source of supply letter and sample submitted for approval.

The recycled concrete shall comply with all requirements for recycled materials referenced in Section TC-6.09.

Material determined by the Engineer to be unsuitable shall be immediately removed from the site to a suitable rubble disposal area at no cost to the County.

901.06.03 Construction. Use of this material shall be limited to applications such as backfill that will NOT be exposed to public view upon completion of the project. Recycled concrete shall not be used as Capping Borrow, as aggregate for Portland Cement Concrete, Hot Mix Asphalt, as part of drainage systems or for mechanically stabilized earth systems. Recycled concrete shall not be used in embankment construction:

- Within 1.5 feet of the top surface of any area to be vegetated,
- Within 2 feet of saturated soil or groundwater conditions, as determined,
- Within 100 feet of any flowing or intermittent surface water course,
- Within 3 feet of any metal pipe or shoring,
- Within 3 feet of any water discharge locations,
- Under permeable or porous surfaces,
- As riprap or gabions exposed to flow of surface or groundwater,
- Where settlement could expose recycled concrete to public view.

Storage of quantities of this material in excess of the amounts necessary for immediate use on the project, as approved by the Engineer, is forbidden. Storage of any quantity of recycled concrete on sites that are residentially zoned shall not exceed a period of 24 hours between the time of delivery and the time of installation.

Grading of recycled concrete (RC) shall be done in accordance with Section 204.02 when RC is used in embankment construction, and shall be used in accordance with Section 916.01 when used as Borrow material.

Compaction of this material shall be as specified for the borrow or backfill in which the recycled concrete aggregate is to be used.

901.06.04 Measurement and Payment. Recycled concrete shall be measured and paid for as part of the borrow or backfill item for which it is being used.

SECTION 902 – PORTLAND CEMENT CONCRETE AND RELATED PRODUCTS

902.01 STORAGE. Storage of materials shall conform to the Contract Documents and as directed by the Engineer.

902.02 CERTIFICATION OF PORTLAND CEMENT AND BLENDED HYDRAULIC CEMENT. The manufacturer shall furnish certification as specified in Section GP-1.05. The certification shall also include:

- (a) The mill shall report its quality control procedures, and submit a new report whenever there is a procedural change.
- (b) The Cement and Concrete Reference Laboratory of the National Institute of Standards and Technology shall inspect the mill's control laboratory on their regularly scheduled visits. The Engineer shall be provided with copies of the reports of these inspections along with an account of the action taken to correct cited deficiencies.
- (c) Records of data accumulated by the quality control procedures shall be produced upon request.

- (d) A certified document shall accompany each shipment stating that the contents conform to all applicable requirements. Additionally, the document shall show the producer's name, mill location, carrier number, date loaded, weight contained in carrier, silo number, consignee, destination, Contract number, and type of cement. The signature and title of the signer shall be shown on the document.
- (e) The mill shall, upon request, supply certified chemical and physical test values that can be associated with any sample representing cement drawn from a particular silo on a given date.
- (f) If test results differ from mill results by more than the precision limits given in the test method, then acceptance of cement by certification will be terminated. The acceptance procedure will then revert to storage testing and approval prior to shipment.

902.03 HYDRAULIC CEMENT.

902.03.01 Portland Cement. M 85, with the fineness and the time of setting determined using T 153 and T 131, respectively.

902.03.02 Ground Iron Blast Furnace Slag. Refer to M 302, Grade 100 or 120. The Contractor may request to substitute a maximum of 50 percent of the weight of cement with ground iron blast furnace slag. When ground iron blast furnace slag is used, the minimum cement factor and water/cement ratio will be determined on the basis of the combined weight of the Portland cement and ground iron blast furnace slag. When ground iron blast furnace slag is used to control alkali silica reactivity, see Table 902 B for percentage.

902.04 BLENDED HYDRAULIC CEMENT. M 240, Type I (PM) containing 15 to 25 percent pozzolan by weight of cement. Maximum loss on ignition is 3.0 percent. Do not use ground iron blast furnace slag for blending. The requirement for a manufacturer's written statement of the chemical composition is waived.

902.05 MASONRY CEMENT. C 91, except the water retention and staining tests are waived.

902.06 CONCRETE ADMIXTURES. Do not use concrete admixtures that contribute more than 200 ppm of chlorides based on the cement content when tested per MSMT 610. Use only prequalified admixtures.

Do not use pozzolan and Type IP cement in the same mix. Since the strength gains are delayed with these materials, a longer period of time may be required for curing and form removal.

902.06.01 Air Entraining Admixtures. M 154.

902.06.02 Chemical Admixtures. M 194, Type A, D, or nonchloride C.

902.06.03 High Range Water Reducing Admixtures. M 194, except that it shall be a liquid, the water content shall be a maximum of 85 percent of that of the control, and the durability factor shall be a minimum of 90. Use Type F for early strength, which shall produce a minimum compressive strength in 12 hours of 180 percent of that of the control. Use Type G when early strength is not specified. The manufacturer shall furnish certification as specified in Section GP-1.05. The certification shall include curves indicating the fluid ounces of admixture per 100 lb of cement as related to water reduction and strength gain for 12 hours when used with a minimum cement factor of 700 lb.

902.06.04 Pozzolans. The use of pozzolans may be requested to control alkali silica reactivity or for other reasons. When a pozzolan is used, determine the minimum cement factor and water/cement ratio on the basis of the combined weight cement and pozzolan. See Table 902 B for percentage of fly ash, and microsilica.

(a) **Fly Ash.** M 295, pozzolan Class C or F, except that the maximum permissible moisture content shall be 1.0 percent, and when used in concrete Mix Nos. 3 and 6 the maximum loss on ignition 3.0 percent.

(b) **Microsilica.** C 1240, except that the oversize requirement is waived.

902.06.05 Corrosion Inhibitors. Corrosion inhibitors shall be calcium nitrite based and contain a minimum of 30 percent active ingredients by mass. The gallonage of corrosion inhibitor used in the concrete mixture shall be included as water when determining the water/cementitious materials ratio.

902.07 PORTLAND CEMENT CONCRETE CURING MATERIALS. Use burlap cloth, sheet materials, liquid membrane forming compounds, or cotton mats.

902.07.01 Burlap. Per M 182, Class 1, 2, or 3.

902.07.02 Sheet Materials. C 171 with the following exceptions:

(a) **White Burlap Polyethylene Sheeting.** Tensile strength and elongation requirements are waived. Use sheeting having a finished product weight of not less than 10 oz/sq.yd..

(b) **White Polyethylene Backed Nonwoven Fabric.** Per Section 902.07.02(a), with the thickness requirement waived. Use material having a finished product weight of not less than 5 oz/sq.yd..

(c) **White Opaque Polyethylene Film.** Tensile strength and elongation requirements are waived.

902.07.03 Liquid Membrane and Water Based Cure and Seal Compounds. Liquid membrane forming compounds and water based cure and seal compounds shall conform to

ASTM C 309 Type II. Cure and seal compounds must not have high gloss finish and must be approved by Baltimore County DPW&T's Division of Construction Contracts Administration prior to use.

Field control testing of the white pigmented curing compounds shall be on the basis of weight per gallon. The samples shall not deviate more than ± 0.3 lb/gal from the original source sample.

902.07.04 Cotton Mats. Cotton mats consist of a filling material of cotton bats or bats covered with unsized cloth and tufted or stitched to maintain the shape and stability of the unit under job conditions of handling.

Use coverings of cotton cloth, burlap or jute having the following properties:

- (a) Cotton cloth covering shall weigh not less than 6.0 oz/sq.yd. and have an average of not less than 32 threads/in. of warp and not less than 28 threads/in. of filling. Use raw cotton, cotton comber waste, cotton card strip waste, or combinations thereof as the raw material used in the manufacture of the cotton cloth.
- (b) Burlap or jute covering for cotton mats shall weigh not less than 6.4 oz/sq.yd. and shall have not less than 8 threads/in. of warp and not less than 8 threads/in. of filling. Use the grade known commercially as "firsts" and they shall be free from avoidable imperfections in manufacture and from defects or blemishes affecting the serviceability.

Use a cotton bat, or bats made of raw cotton, cotton waste, cotton linters, or combinations thereof, as the filling material for the mats. Mats shall weigh not less than 12 oz/sq.yd..

902.08 FORM RELEASE COMPOUNDS. Use form release compounds that effectively prevent the bond of the concrete to the forms. Form release compounds shall not cause discoloration of the concrete or adversely affect the quality or rate of hardening at the interface of the forms.

The flash point of the form release compound shall not be less than 100 F when tested per T 73.

902.09 PARAFFIN WAX. Use clear paraffin wax for use as a bond breaker for concrete. The flash point shall not be less than 380 F when tested under D 92.

902.10 PORTLAND CEMENT CONCRETE. See Section 915 and as specified herein.

902.10.01 Proportioning. Prior to the start of construction, submit to the Engineer the source and proportions of materials to be used for each concrete mix. The mixture shall meet the requirements of Section 902.10.03.

The concrete, with the exception of water and chemical admixtures, shall be proportioned by weight. Water and chemical admixtures may be proportioned by volume or weight. The mix shall be uniform and workable.

902.10.02 Materials.

Coarse Aggregate	901.01
Fine Aggregate	901.01
Cement	902.03 and 902.04
Concrete Admixtures	902.06
Synthetic Fibers	902.15
Water	921.01

902.10.03 Portland Cement Concrete Mixtures.

All Portland Cement Concrete mix designs used on Baltimore County projects must have approval by the Maryland State Highway Administration (MdSHA). The MdSHA mix design approval number must be included on all load tickets. The concrete mixes shall conform to the following:

TABLE 902 A

MIX NO.	PORTLAND CEMENT CONCRETE MIXTURES								
	28 DAY SPECIFIED COMPRESSIVE STRENGTH	STANDARD DEVIATION	CRITICAL VALUE	MIN. CEMENT FACTOR	COARSE AGGREGATE SIZE	MAX. WATER/ CEMENT RATIO	SLUMP RANGE	TOTAL AIR CONTENT	CONCRETE TEMPERATURE
	psi	psi	psi	lb/yd ³	M 43	by wt.	in.	%	F
1	2500	375	2430	455	57, 67	0.55	2 - 5	5 - 8	70 ± 20
2	3000	450	3010	530	57, 67	0.50	2 - 5	5 - 8	70 ± 20
3	3500	525	3600	580	57, 67	0.50	2 - 5	5 - 8	70 ± 20
4	3500	525	3600	615	57, 67	0.55	4 - 8	N/A	70 ± 20
5	3500	525	3600	580	7	0.50	2 - 5	5 - 8	70 ± 20
6	4500	675	4770	615	57, 67	0.45	2 - 5	5 - 8	65 ± 15
7	4200	630	4420	580	57	0.50	1 1/2 - 3	5 - 8	70 ± 20
8	4000	600	4180	750	7	0.42	2 - 5	5 - 8	65 ± 15
9	3000 (a)	N/A	N/A	800	57, 67	0.45	4 - 8	5 - 8	70 ± 20
10	4500	675	4770	700	3/4" - No. 4	0.45	2 - 5	6 - 9	65 ± 15
11	4200	630	4420	-	57, 67	0.45	2 - 5	5 - 8	65 ± 15
12	4200	630	4420	-	3/4" - No. 4	0.45	2 - 5	6 - 9	65 ± 15

NOTES:

- When concrete is exposed to water exceeding 15,000 ppm sodium chloride content, Type II cement shall be used. In lieu of a Type II cement, a Type I cement may be used in combined form with an amount of up to 50 percent replacement with ground iron blast furnace slag, or an amount of up to 25 percent replacement with Class F fly ash. Submit the proposed mix proportions and satisfactory test results per C1012 showing a sulfate resistance expansion not exceeding 0.10 percent at 180 days.
 - The temperature of Mix No. 6 when used for other than superstructure work as defined in GP-1.05 shall be 70 ± 20 F.
 - Type A or D admixture shall be added to bridge, box culvert and retaining wall concrete.
 - Nonchloride Type C admixtures may be used when approved by the Engineer.
 - Other slump requirements:
When a high range water reducing admixture Type F or Type G is specified, the slump shall be 4" to 8".
When synthetic fibers are specified, slump shall be 5" maximum.
When concrete is to be placed by the slip form method, the slump shall be 2 1/2" maximum.
When the absorption of the coarse aggregate is greater than 10%, the slump shall be 3" maximum.
 - Mix 9 shall contain a Type F high range water reducing admixture.
 - Mix 10 and 12 shall be proportioned as specified in 211.2 of the ACI's Recommended Practices for Selecting Proportions for Structural Lightweight Concrete. The maximum average Density of Cured Concrete shall be 118 lb/cu.ft. Control testing for Density of Cured Concrete shall be two companion cylinders for each 100 cubic yards, or fraction thereof, as specified in M 195.
 - Mixes 11 and 12 shall also conform to all requirements as specified in Table 902 C.
- (a) Acceptance will be based on a minimum compressive strength of 3000 psi in 24 hours. Design approval shall be given based on trial batch obtaining a minimum compressive strength of 2500 psi in 12 hours. Testing shall conform to 902.10.08 except that cylinders shall remain in the molds until tests are conducted.

Coarse and fine aggregate having an expansion up to 0.10 percent when tested for alkali silica reactivity (ASR) MSMT 212 may be used without restriction. Aggregates having an expansion greater than 0.10 but less than 0.35 percent are considered reactive and may only be used when one of the options in Table 902 B are employed. Those having an expansion of 0.35 percent and greater are prohibited.

TABLE 902 B

OPTION	ALKALI CONTENT OF CEMENT % max	REPLACE CEMENT WITH		SPECIFICATION
		MATERIAL	% BY WEIGHT	
1	1.50	Class F Fly Ash	15 – 25	M 295
2	1.50	Ground Iron Blast Furnace Slag	25 – 50	M 302 Grade 100 or 120
3	1.50	Microsilica	5 – 7	C 1240
4	-	Blended Cement (a)	100	M 240
5	0.60 (b)	Low Alkali Cement	100	M 85

(a) Pozzolan content of 15 – 25 percent by weight of cement

(b) For Mix 9 used for Portland cement concrete pavement repairs; the maximum allowable percentage of alkalis in Portland cement shall be 0.70.

When reactive aggregate is used, designate which option will be used to control the formation of the ASR gel. If an option other than Option 5 in Table 902 B above is chosen, conduct tests per MSMT 212 using the reactive aggregate and the proposed cementitious material. The expansion test results shall not be greater than 0.10 percent. When more than one reactive aggregate is used in a concrete mix, each shall be tested individually and the maximum amount of pozzolan required to reduce the expansion of all the aggregates to 0.10 percent or less shall be used. Submit the aggregate source, test results, and the percent and type of replacement cement to the Engineer. The Engineer may withhold source approval pending verification testing.

TABLE 902 C

MIX PHYSICAL PROPERTIES		
TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Minimum Cementitious Materials Factor, lb/cu.yd.	—	580
Maximum Content of Portland Cement, lb/cu.yd.	—	550
Water/Cementitious Materials Ratio by Wt.	—	0.45
Corrosion Inhibitor, gal/cu.yd.	Section 902.06.05	2.0
Synthetic Fibers, lb/cu.yd.	Section 902.15	1.5
Permeability of Field Concrete, moving average of three tests, coulombs max	T 277 Modified	2500
Permeability of Field Concrete, individual test, coulombs max	T 277 Modified	3000
Shrinkage at 28 days, microstrains	C 157	400

Note 1: Only Type I or II Portland cement shall be used.

Note 2: Mixes shall contain ground iron blast furnace slag, fly ash or microsilica.

Note 3: The water to cement ratio shall be based upon the total water to cementitious materials ratio. The gallonage of the corrosion inhibitor shall be included in the water/cementitious materials ratio.

- Note 4: The permeability test value of field concrete shall be the average of two test specimens representing production concrete. Test specimens shall be molded on the project site in 4 x 8 in. molds conforming to M 205. Test specimens shall be handled under same conditions as compressive strength test specimens in conformance with C 31 for the first seven days. When seven days old, they shall be cured in a 100 F water bath for the remainder of the 28-day curing. The 28-day rapid chloride permeability of the specimens will be determined in conformance with T 277. Test for the geometry of test specimens will be waived.
- Note 5: Shrinkage tests will be performed on trial mixes only.
- Note 6: High range water reducing admixture may be used except the water reducing requirements will be waived.
- Note 7: A sealer conforming to Section 902.12 shall be used on the finished surface.

902.10.04 Trial Batch. A trial batch shall be prepared to certify that each mix meets the requirements of Sections 902.10.05 and 902.10.06. Approval will be given when the test results meets the minimum required average strength.

Make arrangements with the Engineer at least two weeks in advance, to have an authorized representative present during the batching and testing. Each trial batch shall consist of at least 3 cu.yd. of concrete. Supply all equipment, and labor required to produce the trial batches and conduct the required tests at no additional cost to the County.

The Engineer may waive the requirement for a trial batch when past performance records show that the required average strength requirement has been met.

902.10.05 Design Required Average Strength.

Specified Compressive Strength, f'_c , psi	Required average compressive strength, f'_{cr} , psi
$f'_c \leq 5000$	Use the larger value computed From Eq. (A-1) and (A-2) $f'_{cr} = f'_c + 1.34 s$ (A-1) $f'_{cr} = f'_c + 2.33 s - 500$ (A-2)
f'_c Over 5000	Use the larger value computed From Eq. (A-1) and (A-3) $f'_{cr} = f'_c + 1.34 s$ (A-1) $f'_{cr} = 0.90 f'_c + 2.33 s$ (A-3)

where:

- f'_c = the 28 day specified compressive strength
- s = the standard deviation as specified in Section 902.10.06.

A test is defined as the average strength of two companion cylinders.

902.10.06 Standard Deviation.

- (a) When past performance records are available, a standard deviation will be established from documented performance records of the producer consisting of a minimum of 15 consecutive 28-day compressive strength tests obtained within the last 12 months.

The standard deviation will be established as the product of the calculated standard deviation and multiplier.

NUMBER OF TESTS	MULTIPLIER FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

Interpolate for intermediate number of tests.

- (b) When past performance records are not available, the required average strength shall meet the following:

Specified Compressive Strength, f_c' , psi	Required average compressive strength, f_{cr}' , psi
$f_c' < 3000$	$f_{cr}' = f_c' + 1000$
$3000 < f_c' < 5000$	$f_{cr}' = f_c' + 1200$
$f_c' > 5000$	$f_{cr}' = 1.10 f_c' + 700$

902.10.07 Standard of Control. The average of all sets of three consecutive strength tests shall equal or exceed the critical value as specified in Section 902.10.03, Table 902 A, that shall be computed using the following formula:

$$\text{Critical Value} = f_c' + (1.14 \times S) - 500$$

Failure to conform to this criterion shall be cause for immediate investigation and remedial action up to and including suspension of production. A design standard deviation equal to 15 percent of the specified strength shall be used for calculation until a minimum of 15 test results are obtained.

The actual average strength and standard deviation shall be computed upon the availability of 28-day strength data comprising a minimum of 15 tests. Should this determination indicate an excessive margin of safety, the concrete mix may be modified to produce lower average strength as approved by the Engineer. If these calculations indicate a coefficient of variation greater than 15, the quality of the concrete and testing will be evaluated.

902.10.08 Testing. Sampling per T 141. Testing as follows:

TEST	METHOD	MINIMUM TEST FREQUENCY	RESPONSIBILITY
Temperature (e)	T 309	1 per 50 cu.yd. (or fraction thereof)	Engineer
Slump (a)(e)	T 119	1 per 50 cu.yd. (or fraction thereof)	Engineer
Air Content (a)(e)	T 152 T 196	1 per 50 cu.yd. (or fraction thereof)	Engineer
Compression (b)(c)(d)	T 23	1 per 50 cu.yd. (or fraction thereof)	Engineer
Compression (b)(c)(d) Mix No. 7 Only	T 23	3 per Day	Engineer

- (a) A second test will be made when the first slump or air content test fails. Acceptance or rejection will be based on the results of the second test.
- (b) Compressive strength tests are defined as the average of two companion cylinders.
- (c) The Contractor shall be responsible for the making of all early break cylinders, furnishing the molds and providing weather protection for all cylinders. The Contractor is responsible to deliver all early break cylinders to an AASHTO accredited testing laboratory.
- (d) The Engineer shall be responsible for making, numbering, and delivering the 28-day cylinders to the testing laboratory.
- (e) When constructing plain and reinforced concrete pavements, the testing frequency for slump, air content, and temperature shall be 1 per 100 cu.yd. or fraction thereof.

902.10.09 Acceptance. Concrete will be acceptable if both of the following requirements are met:

- (a) The average of all sets of three consecutive strength tests equal or exceed the specified design strength.
- (b) No individual strength test (average of two companion cylinders) falls below the specified design strength by more than 500 psi.

902.10.10 Price Adjustment. A price adjustment will be based on the Contract unit price per cubic yard of concrete. If the unit is a lump sum item, the price per cubic yard for the concrete will be determined by dividing the cubic yards into the Contract lump sum price.

- (a) **Test Results More Than 500 psi Below the Specified Design Strength.** Failing strength tests will be considered individually with a price adjustment being applied on the percentage basis as shown below.

(Price per cu.yd.) x (quantity of cu.yd. represented by the failing concrete strength) x (percent of failure).

Example:

$$\$400.00 \text{ per cu.yd.} \times 50 \text{ cu.yd.} \times [1 - (3600 / 4500 \text{ psi})] = \$4,000.00$$

No payment will be allowed when the test results fall below 85 percent of the specified design strength for structural concrete or 80 percent for incidental concrete.

The Engineer will determine when the strength of the concrete represented by the failing tests is sufficient to remain in place or whether it must be removed and replaced with Specification concrete.

- (b) Test Results 500 psi or Less than the Specified Design Strength.** Strength failures 500 psi or less than the specified design strength will be averaged with the next two consecutive tests. If those two tests include a failure greater than 500 psi, those tests will be evaluated as in Section 902.10.10(a) and replaced with the next consecutive test. If the resulting average falls below the specified design strength, a price adjustment will be applied as specified in the table below. Any failure will only be included in one grouping.

STRENGTH BELOW THE SPECIFIED (avg of 3 tests) DESIGN LEVEL, psi	ADJUSTMENT FACTOR
MIX NO. 1 THROUGH MIX NO. 12	
1 – 100	0.005
101 – 200	0.01
201 – 300	0.02
301 – 400	0.04
401 – 500	0.08

Adjustment price equals (price per cu.yd.) x (quantity of cu.yd. represented by the failing cylinders) x (the adjustment factor).

Example:

$$\$400.00 \text{ per cu.yd.} \times 50 \text{ cu.yd.} \times 0.01 = \$200.00$$

902.11 MORTAR FOR GROUT. Mortar used for grouting anchor bolts, pipe, handrail posts, and miscellaneous items shall be composed in accordance with one of the following:

- (a) One part Portland cement or blended hydraulic cement and one part mortar sand by dry loose volume.
- (b) Prepared bag mixes consisting of Portland cement or blended hydraulic cement and mortar sand. The prepared mixes shall produce a mortar meeting the strength requirements specified in the Contract Documents.
- (c) Use non-shrink grout when specified. The grout shall have a minimum compressive strength of 5000 psi in seven days when tested as specified per T 106, except that the cube molds shall remain intact with a top firmly attached throughout the curing period. The non-shrink grout shall have no expansion or contraction after seven days when tested as specified per T 160.

- (d) Epoxy grout shall consist of sand and epoxy mixed by volume in per the manufacturer's recommendations. The grout shall be capable of developing a minimum compressive strength of 6500 psi in 72 hours when tested per MSMT 501. Sand for epoxy grout as specified in Section 901.01, Table 901 A.
- (e) An epoxy or polyester anchoring system may be used when approved by the Engineer in accordance with the manufacturer's recommendations. Strength values shall be as specified in the Contract Documents.

902.12 LINSEED OIL. Shall consist of a 50-50 mixture (by volume) of boiled linseed oil meeting Federal Specification TT-L-190 and kerosene per D 3699.

902.13 LATEX MODIFIED CONCRETE. Portland cement concrete containing prequalified Laboratory approved styrene butadiene latex emulsion is defined as Latex Modified Concrete (LMC).

Latex emulsion shall have a minimum of 90 percent of the nonvolatiles as styrene butadiene polymers. The latex emulsion is specified in Table 902.13 A. The material shall be stored in suitable containers and be protected from freezing and exposure to temperatures in excess of 85 F.

LMC shall be proportioned using volumetric mixing and designed as follows:

LATEX MODIFIED CONCRETE	
MATERIAL	SPECIFICATION LIMITS
Portland Cement, 100 lb./cu.yd., min.	6.6
Latex Emulsion/Cement Ratio	0.31 – 0.34
Water/Cement Ratio, max	0.22
Entrained Air, %	6.0 ± 3
Slump, in.	5 ± 1

The physical properties of LMC shall conform to Table 902.13 B. The Contractor shall furnish the necessary 3 x 6 in. molds per M 205 to be used for the fabrication of compressive strength cylinders.

Control and Acceptance Sampling.

- (a) Submit a two qt minimum sample, of the styrene butadiene latex emulsion to the Engineer daily for each lot of material used in a day's production.
- (b) A batch for LMC is defined as the capacity of the equipment being used on the project. Slump and air samples will be taken and tested before the placement of a batch is permitted. The slump shall be measured four to five minutes after discharge from the mixer. The test material shall be deposited off the deck and not be disturbed during this waiting period. One additional sample for slump and air will be taken randomly during the placement of each batch. For seven day compressive strength,

two tests each per batch are required. A test is defined as consisting of two companion cylinders. The samples for these tests will be taken at random while the placement is in progress.

TABLE 902.13 A

REQUIREMENTS FOR CHEMICAL PROPERTIES OF LATEX EMULSION MATERIALS				
PROPERTY	SPECIFICATIONS		QUALITY ASSURANCE TESTS	
	LIMITS	TOLERANCE	PREQUALIFICATION TESTS	CONTROL AND ACCEPTANCE
Color	White	—	X	X
pH	9.0 – 11.0	—	X	X
Weight, lb/gal	8.40 – 8.47	—	X	X
Solids Content, %	46 – 53	—	X	X
*Butadiene Content, % of polymer	30 – 40	—	—	—
Viscosity @ 10 rpm-cps	Match Original	± 20	X	X
*Surface Tension, dynes/cm max	50	—	—	—
*Mean Particle Size, polymer – Å	1400 – 2500	—	—	—
Coagulum, % max	0.10	—	X	X
*Freeze-Thaw Stability, coagulum, % max	0.10	—	X	X
Infrared Spectra of Latex Film	Match Original	—	X	X
Infrared of Alcohol, Soluble Portion of Latex	Match Original	—	X	X
Shelf Life, min	1 yr	—	X	—

Note 1: Quality assurance tests shall be conducted as specified in MSMT 612 except those denoted by an * shall be conducted as specified in FHWA RD – 78-35.

Note 2: The original or prequalification sample shall be accompanied by the producer's certification on all of the tests and properties noted above and as specified in Section GP-1.05. The certification shall contain actual test values of the product and the infrared spectrograph.

Note 3: A separate certification is required for each lot of material. The certification shall note the date of manufacture, lot size, and whether or not the material is identical to the formulation of the original sample.

TABLE 902.13 B

LATEX MODIFIED CONCRETE PHYSICAL PROPERTIES			
TEST PROPERTY	TEST VALUES	QUALITY ASSURANCE TESTS	
		PREQUALIFIED TESTS	CONTROL AND ACCEPTANCE
7 Day Compressive Strength, psi min	3000	X	X
28 Day Compressive Strength, psi min	3500	X	—
42 Day Compressive Strength, psi min	3500	X	—
7 Day Flexural Strength, psi min	550	X	—
28 Day Flexural Strength, psi min	650	X	—
42 Day Shear Bond Strength, psi min	2000	X	—
Durability Factor, 300 cycles, % min	85	X	—
Chloride Permeability, Ppm max	510	X	—
Scaling Resistance, 50 cycles, max	3	X	—

Note 1: Quality assurance tests shall be conducted as specified in MSMT 721.

Note 2: Seven Day Compressive Strength Test will be used for Control & Acceptance of the material. The minimum specified design strength is 3000 psi at seven days. The mix design approval and acceptance will be based on a coefficient of variation of 10 percent with a probability of 1 in 10 tests falling below the specified strength. Only test values 80% or greater than the specified strength will be accepted.

902.14 RAPID HARDENING CEMENTITIOUS MATERIALS FOR CONCRETE PAVEMENT REPAIRS. Materials shall be a dry, packaged cementitious mortar having less than 5 percent by weight of aggregate retained on the 3/8 in. sieve and meet the following requirements:

Classification.

Class I — For use at ambient temperatures below 50 F.

Class II — For use at ambient temperatures of 50 to 90 F.

Class III — For use at ambient temperatures above 90 F.

Chemical Requirements. C 928 except that no organic compounds such as epoxy resins or polyesters as the principal binder.

Physical Requirements. Meet the following when tested per MSMT 725:

COMPRESSIVE STRENGTH, psi min				
CLASSIFICATION	< 2 hr	2-6 hr	6 hr	28 days
Type I — Slow	—	—	2000	4500
Type II — Rapid	—	2000	—	4500
Type III — Very Rapid	2000	—	—	4500

TEST RESULTS	
TEST PROPERTY	LIMITS
Bond Strength, 7 days, psi min	2000
Length Change, increase after 28 days in water, based on length at 3 hr, % max	+ 0.15
Length Change, decrease after 28 days, % max	- 0.15
Freeze Thaw, loss after 25 cycles in 10% Calcium Chloride solution, % max	8
Initial Setting Time, minutes min	10

Marking. All packages delivered to the project shall be marked with the following information:

- (a) Date material was packaged.
- (b) Approximate setting time.
- (c) Recommended dosage of water or liquid component.
- (d) Mixing instructions.
- (e) Class or temperature range.

Certification. The manufacturer shall furnish certification as specified in Section GP-1.05 showing the actual test results for each class and type of material submitted to the Laboratory.

902.15 SYNTHETIC FIBERS. When synthetic fibers are specified in the Contract Documents, the fibers shall be ½ to 1-1/2 in. long and conform to C 1116, Type III. The manufacturer shall furnish certification as specified in Section GP-1.05. The quantity of fibers used and their point of introduction into the mix shall conform to the fiber manufacturer's recommendations.

902.16 CONTROLLED LOW STRENGTH MATERIAL.

902.16.01 Usage. Controlled Low Strength Material (CLSM) shall consist of the types described below:

TYPE A – Used where future excavation of the CLSM may be necessary (e.g. utility trenches, pipe trenches, bridge abutments, and around box culverts).

TYPE B – Used where future excavation of the CLSM is not anticipated (e.g. filling abandoned conduits, pipes, tunnels, mines, etc. and replacing unsuitable soils below roadway and structure foundations where extra strength is required).

902.16.02 Materials.

Coarse Aggregate	901.01*
Fine Aggregate	901.01
Cement	902.03 and 902.04
Concrete Admixtures	902.06
Fly Ash	902.06.04
Water	921.01

*maximum size of 3/4 in.

Produce CLSM in conformance with the applicable portions of Section 915 and the following:

902.16.03 Proportioning. Submit the sources and proportions of materials, and test data for each CLSM mixture prior to construction. CLSM shall be proportioned, on the basis of field experience and/or laboratory trial mixtures, to produce a flowable and self-compacting mixture meeting the requirements of Section 902.16.04.

CLSM shall be proportioned by weight; with the exception of water and chemical admixtures. Water and chemical admixtures may be proportioned by volume or weight.

902.16.04 CLSM Mixtures. Proportion CLSM with sufficient amounts of Portland cement, fly ash, or ground granulated blast furnace slag; individually or in combination, to produce a cohesive, non-segregating mixture that conforms to the physical properties in the following table:

CLSM Mix	28 Day Compressive Strength, (psi) ASTM D4832	Flow Consistency, (in.) ASTM D6103
Type A	50 - 200	8 min.
Type B	500 min.	8 min.

SECTION 903 – MASONRY PRODUCTS

903.01 SEWER BRICK. Sewer brick shall have a standard size of 2 1/4 x 3 3/4 x 8 in. and conform to C 32, Grade SS. See Standard Detail Plates for sewer manholes. Use solid brick except as otherwise directed by the Engineer.

903.02 MANHOLE BRICK. Manhole brick shall conform to C 32, Grade SM.

903.03 BUILDING BRICK. Building brick shall conform to C 62, Grade SW.

903.04 HOLLOW CONCRETE MASONRY BLOCK. Hollow load bearing concrete masonry block shall conform to C 90, Class I, normal weight.

903.05 SOLID CONCRETE MASONRY BLOCK. Solid concrete masonry block shall conform to C 139 or C 90 as applicable.

903.06 MORTAR FOR MASONRY. Mortar used for masonry shall be composed in conformance with one of the following:

- (a) One part Portland cement or blended cement and three parts mortar sand by dry loose volume and hydrated lime not to exceed 20 percent of the cement by weight;
- (b) One part masonry cement and three parts mortar sand by dry loose volume;
- (c) Prepared bag mixes consisting of masonry cement and mortar sand. The prepared mixes shall produce a minimum compressive strength of 500 psi in seven days when tested using the applicable procedures specified in C 91.

Materials for mortar shall conform to the following:

Mortar Sand	901.01
Portland Cement	902.03
Blended Cement	902.04
Masonry Cement	902.05
Water	921.01
Lime	921.03

SECTION 904 – PERFORMANCE GRADED ASPHALT BINDERS AND HOT MIX ASPHALT

904.01 CERTIFICATION. The manufacturer and hauler shall furnish certifications as specified in Section GP-1.05 and the following:

The manufacturer shall also certify:

- (a) Date and time of loading.
- (b) Tank or blending system.
- (c) Identification of hauling unit.

- (d) Binder grade, temperature, and quantity of materials.
- (e) Complete certified analysis.
- (f) Lot number, if applicable.
- (g) Mixing and compaction temperatures.

The hauler shall also certify:

- (a) Identification of hauling unit.
- (b) Binder grade and source of last delivery.
- (c) The date of the last delivery using this hauling tank and volume of material remaining in the tank at the time of current loading.

904.02 PERFORMANCE GRADED ASPHALT BINDERS. Performance graded asphalt binders for mixes containing all virgin materials, recycled asphalt pavement materials, or roofing shingles from manufacturing waste shall conform to M 320, Table 1, for the specified performance grade. The asphalt binder recovered from the final plant mixed material will be considered Rolling Thin Film Oven (RTFO) material and shall conform to M 320, Table 1 for the specified performance grade.

The performance-graded binder shall be pre-approved by the Engineer. The Contractor shall submit a certificate of analysis showing conformance with the Performance Graded Binder Specification M 320 and showing the critical cracking temperature in conformance with PP 42, *Standard Practice for Determination of Low-Temperature Performance Grade (PG) of Asphalt Binder*, for the binders specified in the Contract Documents.

The PG binder for HMA mixes shall be achieved by the use of Neat Asphalt with elastomer polymer modifications when needed.

904.03 EMULSIFIED ASPHALTS. Emulsified asphalts shall conform to M 140 or M 208 with the following exceptions:

- (a) Cement mixing tests are waived.
- (b) Grade SS-1 viscosity shall be 50 to 400 seconds at 77 F.
- (c) Maximum of 3.0 percent by volume of oil distillate.
- (d) The sieve test requirement for field samples shall be a maximum of 0.4 percent.

904.04 HOT MIX ASPHALT (HMA). Mixes shall be produced in a plant as specified in Section 915.

904.04.01 Aggregates. Aggregates shall conform to Section 901, and M 323 with the exception that the aggregate retained on the 4.75 mm sieve shall be tested for flat and elongated particles in conformance with D 4791. When recycled asphalt pavement is used in an HMA mix as defined in MSMT 412, it shall be considered an aggregate source.

904.04.02 Mix Design. The Contractor shall develop a Superpave mix design in conformance with MSMT 416 and M 323, except replace “Table 6, Superpave HMA Design Requirements” with the following Table:

DESIGN LEVEL	20-Year Design Traffic, ESALs	Ndesign
1	<300,000	50
2	300,000 to <3,000,000	65
3	3,000,000 to <10,000,000	80
4	10,000,000 to <30,000,000	80
5	≥30,000,000	100

Design asphalt mixes to the Design Level specified in the Contract Documents.

Asphalt mixes designed with Reclaimed Asphalt Pavement (RAP) and/or Reclaimed Asphalt Shingles (RAS) shall conform to MSMT 412.

All HMA material used on Baltimore County projects must be Maryland State Highway Administration (MdSHA) approved mixes. HMA Superpave mixes shall conform to the specification for Superpave Volumetric Mix Design, M 323, and shall be designed for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

The contractor may elect to use crushed, recycled asphalt pavement (RAP) material or a maximum of 5 percent roofing shingles from manufacturing waste. Shingles processed from this waste must be ground, screened to a minus 3/8” size and blended with stabilizing aggregate which shall be processed through a fully automated blending facility prior to being incorporated into the hot mix asphalt production facility. All facilities choosing to incorporate shingles into their mixes must be pre-approved by Baltimore County.

Surface mixes using 20 percent or more RAP and base mixes using more than 25 percent RAP shall be tested and evaluated in accordance with TP62, “Determining Dynamic Modulus of Hot Mix Asphalt Concrete Mixtures”, to determine plant mixing capabilities. A demonstration strip or mix verification may be required before placement. When using less than 20 percent RAP, binder grade adjustments are not required.

The use of RAP, not to exceed 10 percent, may be considered for applications where higher polish value aggregates are required and in mixes requiring elastomer type polymer binder. Approval for use will be on an individual project basis. Documentation of RAP stockpile quality and traceability shall be submitted to the Engineer for approval prior to use.

Crushed glass shall not be used in surface mixes. RAP and roofing shingles from manufacturing waste shall not be used in gap-graded mixes, surface mixes requiring high polish aggregate, or mixes requiring elastomer type polymer binder. Shingle mixes shall only be used for base course mixes.

904.04.03 Mix Design Approval. At least 30 days prior to paving operations, submit data from the laboratory study to the Engineer for tentative approval. Submit mix designs in an approved format. Include the following:

- (a) Mix designation.
- (b) Source, percentage, and grade of performance graded asphalt binder.
- (c) Source, gradation, and proportion of each component aggregate.
- (d) Target aggregate gradation.
- (e) Plant where the HMA mix will be produced.
- (f) Plant target mixing temperature based on viscosity of 0.22 Pa·s.
- (g) Ratio of dust to binder material on effective asphalt.
- (h) Maximum specific gravity at the target binder content.
- (i) Mix design grading plotted on 0.45 power gradation chart.
- (j) Tensile strength ratio and worksheets.
- (k) The bulk specific gravity at N_{design} gyrations.
- (l) The air void content (percent V_a) at N_{design} gyrations.
- (m) The voids in the mineral aggregate (percent VMA) and the voids filled with asphalt (percent VFA) at N_{design} gyrations (T 312).
- (n) All consensus and source properties.
 - (1) Coarse aggregate angularity.
 - (2) Flat and elongated.
 - (3) Sand equivalent.
 - (4) Uncompacted void content of fine aggregate.

(5) Bulk and apparent specific gravity of coarse and fine aggregate.

(6) Absorption of coarse and fine aggregate.

With each mix design submitted to the Engineer for approval, include a quantity of job mix formula aggregate and appropriate amount of required PG binder for ignition oven calibration.

If previous construction or performance experience has shown the proposed mix design to be unsatisfactory, the Engineer may require that a more suitable design be submitted.

When a change to the source of aggregate used in the mix is proposed, submit a revised mix design with the information required above and in Section 904.04.02. If a change in the Performance Grade binder source becomes necessary, conduct a stripping test in conformance with MSMT 410, prior to approval. The Engineer may require an antistripping additive test in conformance with D 4867 before giving the final approval.

Field Verification of Mix Design. After receiving tentative approval for the mix design from the Asphalt Technology Chief Representative, conduct a field verification of the mix at the beginning of production in each plant. Field verification shall be performed by the certified personnel as specified in Section 504.03. Prepare the verification samples per R 35. Notify the Engineer at least two working days in advance of the scheduled verification.

Verification Evaluation.

- (a) Initial verification shall consist of four samples tested for the parameters listed in MSMT 735, Table 2. These samples shall be randomly drawn from the first day's production. If the first day of production is less than 2000 tons, the verification testing may be spread over the number of days needed to accumulate 2000 tons. A verification sample and test is required on any day that exceeds 200 tons of production. Complete the verification testing no later than on the day when production has reached the 2000 tons. Evaluate the verification tests results as specified in MSMT 735.
- (b) If the mix produced by the plant conforms to the parameters listed in MSMT 735, Table 2 with a Percent Within Specification Limit (PWSL) of at least 85, production may proceed without any changes. If the Contractor has submitted mixes with identical aggregate combinations and differing asphalt contents associated with changes in ESAL loads, verification may be limited to volumetric analysis at the Engineer's discretion.
- (c) If the mix produced by the plant does not conform to the parameters listed in MSMT 735, Table 2 with a PWSL of at least 85, then an adjustment to the asphalt content or gradation may be made to bring the mix design requirements within acceptable levels.

Permissible adjustment limitations between the approved Mix Design and Adjusted Mix Design are as follows:

TEST PROPERTY	PERMISSIBLE ADJUSTMENT % (*)
Larger than 1/2 in. (12.5 mm) sieve	± 5
1/2 in. (12.5 mm) through No. 4 (4.75 mm) sieves	± 4
No. 8 (2.36 mm) through No. 100 (1.50 μm) sieves	± 3
No. 200 (75 μm) sieve	± 1.0
Binder Content	± 0.20

*The permissible adjustment for all mixes shall be within control points.

When an adjustment is made to the mix design, perform a second verification to ensure that the modified mix conforms to all design requirements. Meet the time and tonnage limitations as specified in (a). If the adjusted mix meets the PWSL, production may proceed. If the mix does not meet these requirements, suspend production for the mix and submit a new mix design for approval. Design the new mix as specified in MSMT 412 or R 35.

- (d) If subsequent designs submitted due to nonconformance do not meet (b) during the initial verification, suspend production for the mix until corrective action is taken as approved by the Engineer.

Thin Lifts. When specified lift thickness does not meet 3-times nominal maximum aggregate size for fine graded mix designs or 4-times nominal maximum aggregate size for coarse graded mix designs, the lift thickness shall be designated as a thin lift. Fine graded and coarse graded mix designs shall be determined in accordance with M 323, Table 4, Gradation Classification, and the table below.

Thin Lift Mix Design Identification Table

Mix Designation	Gradation Classification Control Sieve Mix Design Target (%Passing)	
	Fine Graded	Coarse Graded
4.75mm	A thin lift is a specified pavement thickness < 1 inch.	A thin lift is a specified pavement thickness < 1 inch.
9.5mm	When the 2.36mm (#8) is ≥ 47%, a thin lift is a specified pavement thickness < 1 1/8 inches	When the 2.36mm (#8) is < 47%, a thin lift is a specified pavement thickness < 1 1/2 inches
12.5mm	When the 2.36mm (#8) is ≥ 39%, a thin lift is a specified pavement thickness < 1 1/2 inches	When the 2.36mm (#8) is < 39%, a thin lift is a specified pavement thickness < 2 inches
19.0mm	When the 4.75mm (#4) is ≥ 47%, a thin lift is a specified pavement thickness < 2 1/4 inches	When the 4.75mm (#4) is < 47%, a thin lift is a specified pavement thickness < 3 inches

Mix Designation	Gradation Classification Control Sieve Mix Design Target (%Passing)	
	Fine Graded	Coarse Graded
25.0mm	When the 4.75mm (#4) is $\geq 40\%$, a thin lift is a specified pavement thickness < 3 inches	When the 4.75mm (#4) is $< 40\%$, a thin lift is a specified pavement thickness < 4 inches
37.5mm	When the 9.50mm (3/8) is $\geq 47\%$, a thin lift is a specified pavement thickness < 4 inches	When the 9.50mm (3/8) is $< 47\%$, a thin lift is a specified pavement thickness < 6 inches

904.04.04 Antistripping Additives. HMA shall have a minimum Tensile Strength Ratio (TSR) of 0.85 when tested in conformance with D 4867. The freeze-thaw conditioning cycle is required. HMA mixes not conforming to the minimum TSR requirement shall include an antistripping additive.

When an antistripping additive is needed, the exact quantity shall be determined by the producer in conformance with D 4867 based on a minimum TSR of 0.85.

When a heat stable antistripping additive is used, the minimum dosage rate shall be 0.20 percent of the total weight of asphalt. The additive shall be introduced at the plant by line blending, metering, or otherwise measuring to ensure accurate proportioning and thorough mixing.

When hydrated lime is used, it shall be added in slurry form at the rate of 1.0 to 1.5 percent by weight of total aggregate. The hydrated lime shall conform to C 1097. Lime slurry shall be sprayed uniformly on the damp, cold aggregate on the feed belt prior to entry into the HMA plant dryer.

Plant control and acceptance of the mix shall be based on MSMT 410 with respect to its stripping potential.

904.04.05 Plant Control. Reserved.

SECTION 905 – PIPE

The manufacturer shall furnish certification for all pipe as specified in Section GP-1.05.

905.01 Materials, Use, Specifications, and Remarks.

MATERIAL	USE	SPECIFICATION	REMARKS
Ductile Iron Pipe (Note 1)	Sewer	AWWA C 150 and C 151	Gravity Sewer Class 52
	Pressure	AWWA C 150 and C 151	Water & Sanitary Sewer Force Main, Class 54
	Pressure	AWWA C 115	Flanged pipe, thickness corresponding to Class 54
	All	AWWA C 110 and C 153	Fittings
Steel Pipe	Pressure	AWWA C 200	Exterior coating as specified. Cement mortar lining as specified.
Concrete Pipe -Prestressed Pressure Pipe, Steel Cylinder Type (PCCP) -Drain Tile -Nonreinforced -Reinforced Circular -Reinforced Arch -Reinforced Elliptical -Low Head Pressure -End Sections	Water & Sewer	AWWA C 301, C 304	Note 2
	Drainage	M 178	-
	Drainage	M 86, Class 3	-
	Drainage & Sewer	M 170, Class IV & V	M 170 Load Bearing Option
	Drainage	M 206	-
	Drainage	M 207	M 207 Load Bearing Option Class HE IV
	Drainage	ASTM C 361	-
	Drainage	M 170	Class III Pipe Reinforcement Required
Polyethylene Pipe -Corrugated Pipe -Corrugated Drainage Pipe HDPE Pipe & Fittings HDPE Pipe & Fittings	Drainage	M 294	15" to 24" I.D. (Note 3)
	Drainage	M 252	Perforated Underdrain & UD outlet pipes - Type S. Minimum pipe stiffness 50 psi (Note 4)
	Water	AWWA C 906	Potable Water, 4" to 30", with BCBE approval
	Sewer	ASTM D 1248, SDR 11	Pressure Sewer
Polypropylene Pipe -Corrugated Pipe	Drainage	M 330, Type S or Type D	15" to 24" I.D. (Note 3)
Polyvinyl Chloride (PVC) Pipe (PVC) Pipe (PVC) Sewer Pipe (PVC) Sewer Pipe	Drainage	M 278	Underdrain Outlet Pipes, Perforated UD (Note 4)
	Drainage	AASHTO Bridge Sec. 18 PVC Rigid Pipe	24" or smaller
	Sewer	ASTM D 3034 SDR 35 (4"-15")	Jointing: ASTM D 3212 "Push-On"
	Sewer	ASTM F 679 (18"-48") Pipe Stiffness 75 (Note 5)	Joints using Locked-in Elastomeric Seal.
	Sewer	ASTM D 1785 Sch 40 or 80 ASTM D 2241, D 3139 SDR21	Pressure Sewer (less than 2" dia.) Pressure Sewer (2" or larger dia.)
Preformed Rubber	Drainage	C 990	Joint for Circular Pipe
Corrugated Steel Pipe, Pipe Arches & Underdrain Structural Plate Pipe, Pipe Arches & Arches Polymer Pre-Coated Corrugated Steel Pipe	Drainage	M 36	For repair & with prior DPW&T approval only.
	Drainage	M 167	NOT USED
	Drainage	M 245 & M 246	NOT USED
Corrugated Aluminum Alloy Pipe	Drainage	M 196	NOT USED
Copper Pipe	Water	ASTM B-88	Water service - Type K required.

Note 1 - Pressure Rating Through 24": 350 psi. Pressure Rating 30" -48": 300 psi.

Note 2 - Detailed drawings and schedules per AWWA C 301 Sec. 4.3.1 and Affidavit of Compliance per AWWA C 301, Section 6.3 to be submitted.

Note 3 - Not permitted for sizes greater than 24" diameter.

Note 4 - Underdrain perforations shall conform to F 758.

Note 5 - Subject to approval by the Engineer, Pipe Stiffness 115 pipe may be substituted for Pipe Stiffness 75 pipe.

905.01.01 Marking Non-Reinforced and Reinforced Concrete Pipe. Non-reinforced and reinforced pipe sections shall be provided to the County with the following information clearly marked on each pipe section:

- Pipe Class,
- Specification designation:
 - AASHTO M 86 ... Non-Reinforced Concrete Pipe,
 - AASHTO M 170 ... Reinforced Concrete Circular Pipe,
 - AASHTO M 206 ... Reinforced Concrete Arch Pipe,
 - AASHTO M 207 ... Reinforced Concrete Elliptical Pipe,
- The date of manufacture,
- The name or trademark of the manufacturer, and
- Plant identification.

Circular pipe sections with elliptical or quadrant reinforcement shall have, in addition, one end marked during or immediately following manufacture as follows:

- Elliptical reinforced sections shall be marked on the inside and outside of opposite walls along the minor axis of the elliptical reinforcing,
- Quadrant reinforced sections shall be marked on the inside and outside of opposite walls along the vertical axis for quadrant reinforcing.

Elliptical pipe with quadrant reinforcement shall be marked with the letter “Q”. Marking shall be indented into the pipe section or painted thereon with waterproof paint.

905.01.02 Marking Corrugated Steel Pipe. Corrugated steel pipe shall be marked per manufacturer’s practice and Special Provisions in accordance with Contractor’s need to identify pipe size and gauge. Coating & lining shall be performed at the construction site.

905.01.03 Marking Corrugated Aluminum Pipe. Reserved.

905.01.04 Marking Polyethylene (PE) and Polypropylene (PP) Drain Pipe. All pipes shall be clearly marked at intervals of no more than 10 feet as follows:

- Manufacturer’s name or trademark,
- Nominal size,
- Specification designation; AASHTO M 294 for polyethylene pipe or AASHTO M 330 for polypropylene pipe,
- Plant designation code,
- Date of manufacture or appropriate equivalent code.

Fittings shall be marked with the designation number specification AASHTO M 294 for polyethylene pipe or AASHTO M 330 for polypropylene pipe; and with the manufacturer’s identification symbol.

905.01.05 Marking Polyvinyl Chloride (PVC) Drain Pipe. All pipes shall be clearly marked at intervals of no more than 10 feet, with 3/8" or larger letters, and fittings shall be clearly marked, as follows:

- Manufacturer's name or trademark,
- Nominal size,
- Specification designation, AASHTO M 278,
- Plant designation code.

The pipe shall be tagged with the date of manufacture. All bends made from the pipe shall be marked to show the angle and radius of curvature, in addition to the pipe information listed above. Markings on perforated pipe shall be placed 180° from a point equidistant between the bottom two rows of holes.

A "home" mark, located on the spigot end, indicates the proper position of the bell end when the spigot end has been fully inserted.

905.01.06 Marking Polymer Precoated Corrugated Steel Pipe. Reserved.

905.01.07 Marking Concrete Drain Tile. Concrete drain tile shall be marked per manufacturer's practice and per Special Provisions in accordance with Contractor's need to identify pipe size, etc. at the construction site.

905.01.08 Marking Polyvinyl Chloride (PVC) Plastic Perforated Underdrain. The marking shall be applied to the pipe in such a manner that it remains legible after installation and inspection.

All pipes shall be clearly marked at intervals of no more than 5 feet, with 3/8" or larger letters, as follows:

- Manufacturer's name or trademark,
- Nominal pipe size,
- Material designation (cell classification),
- Optional: the words "HIGHWAY UNDERDRAIN",
- "Type PS 28" or "Type PS 46",
- Specification designation, ASTM F 758, and
- Date of manufacture, plant designation and other control symbols internally required by the manufacturer.

Markings on perforated pipe shall be placed 180° from a point equidistant between the bottom two rows of holes.

All bends and fabricated fittings shall be marked as follows:

- Manufacturer's name or trademark,
- Nominal size,
- Material designation (PVC),
- Specification designation, ASTM F 758, and
- Bends shall also be marked to show degree and radius of curvature (e.g.: 90° 24 in. R).

905.01.09 Marking Polyvinyl Chloride (PVC) Sewer Pipe. All pipes shall be clearly marked at intervals of 5 ft or less, as follows:

- Manufacturer's name or trademark and code,
- Date of manufacture,
- Nominal pipe size,
- The PVC cell classification (e.g.: 12454),
- A legend, as follows:
 - (4" to 15" Dia.): "Type PSM SDR-35 PVC Sewer Pipe",
 - (18" to 48" Dia.): "PS 75 PVC Sewer Pipe", or "PS 115 PVC Sewer Pipe".
- Specification designation, as follows:
 - (4" to 15" Dia.): ASTM D 3034,
 - (18" to 48" Dia.): ASTM F679.

All bends and fabricated fittings shall be marked as follows:

- Manufacturer's name or trademark (and code for 18" to 48" Dia.),
- Date of manufacture,
- Nominal size,
- Material designation (PVC),
- Specification designation, as follows:
 - (4" to 15" Dia.): ASTM D 3034,
 - (18" to 48" Dia.): ASTM F679.

905.01.10 Marking Reinforced Concrete Sewer Pipe, Pressure Type Non-Cylinder. Each length of straight and special pipe and each fitting shall be plainly marked inside, near one end. The markings shall include either the pressure and external load for which the pipe or fitting is designed or the area of steel per linear foot in circumferential reinforcement. Special marks of identification, sufficient to show the proper location of pipe or fitting in the line by reference to layout drawings and schedules shall be placed on the pipe if specifically required in the Contract Documents. All beveled pipes shall be marked with the amount of the bevel, and the point of maximum pipe length shall be marked on the beveled end. If elliptical reinforcement is used, the minor axis of the reinforcement shall be identified. Markings shall be made on the pipe with a waterproof marking material.

905.01.11 Marking Cast Iron Soil Pipe. Each length of pipe and each fitting shall be plainly marked with the country of origin, the manufacturer's initials or registered trademark by which the manufacturer can be readily identified after installation, and with the letters "XH" (Extra Heavy).

The markings shall be cast, stenciled or otherwise applied on the pipe so as to be clear and legible after installation. The marking shall be cast on fittings and shall be clear and legible after installation and located away from the spigot end so as not to interfere with proper joining upon installation.

905.01.12 Marking Prestressed Concrete Pressure Pipe, Steel Cylinder Type. The manufacturer's control number or work order number pertaining to any given section of pipe shall be stamped on the spigot joint ring when production has begun and shall be legibly and

indelibly marked on the concrete interior of the pipe following curing. All inspection reports and production records shall reference the control number or work order number. Each standard pipe shall be marked to designate its strength classification. Beveled pipe and elbows shall be marked to indicate the angle and direction of laying considering the location of the bevel. Each fitting or special shall be sufficiently marked to indicate its position in the pipeline. Pipe sections with steel cylinders thicker than standard shall be so marked.

905.01.13 Marking Steel Pipe. A serial number or other identification shall be painted in a conspicuous location on each section of pipe and each special section. If the pipe is coated or lined, such marking shall be done at the shop and later transferred to the coating or lining. The pipe manufacturer may be required to furnish the Contractor and Engineer with line diagrams, or laying schedules, showing where each numbered pipe or special section belongs in the pipeline. The numbers on such diagrams, or schedules, shall correspond to those painted on the pipes and special sections.

905.01.14 Marking Ductile Iron Pipe. The class or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and letters and numerals on pipe sizes 14 inches and larger shall be not less than ½ inch in height. When required in the Contract Documents, initials not exceeding four in number shall be cast or stamped on the pipe. All required markings shall be clear and legible, and cast or metal stamped marks shall be on or near the bell.

When zinc-coated pipe is specified in the Contract Documents, manufacturer's name shall be marked in the approximate middle of the barrel followed by the word "Zinc" with a 2-inch wide circumferential band of silver / gray-toned coating applied approximately 2 inches on both sides of that marking. If pipe is cut in the field in such a way that the zinc label is removed or otherwise obstructed, paint a circumferential band around one end of the pipe being installed using light grey or silver paint.

In addition to the requirements mentioned above, all "gauged full length" ductile iron pipe shall be clearly marked with at least two green hash marks on the pipe exterior at the bell end. Hash marks shall be made with waterproof green paint and be a minimum of two inches wide.

905.01.15 Packaging & Package Marking Copper Pipe. Each shipping unit shall be legibly marked with the purchase order number, metal or alloy designation, temper, size, total length or piece count or both, and name of supplier. The specification number shall be shown, when specified.

The name or trademark of the manufacturer and the mark indicative of the type shall be permanently (incised) marked on each tube at intervals not greater than three feet. Tube in straight lengths shall be further identified throughout its length by means of a continuous colored stripe, symbol, or logo not less than 3/16 inch in height, including a legend repeated at intervals not greater than 3 feet. The legend shall include the type of the tube, name or trademark of the manufacturer or both, and the country of origin. Other information may be included at the option of the manufacturer.

Type K copper tubing shall have a green color stripe. Such color marking is not applicable to tube furnished in annealed straight lengths or coils.

905.01.16 Marking High Density Polyethylene (HDPE) Water Pipe. All pipe shall bear identification markings that shall remain legible during normal handling and storage. The markings shall be applied in a manner that will not reduce the strength or otherwise damage the pipe. Required markings on the pipe shall include the following and shall be applied so that intervals between markings are no greater than 5 feet:

- Nominal Size and OD base (such as 12” DIOD)
- Standard material code designation (such as PE 4710)
- Dimension ratio (such as DR 11)
- Pressure Class (such as PC 200)
- AWWA designation number in effect at time of manufacture (such as AWWA C906-15)
- Manufacturer’s production code to include day, month and year.

All HDPE water pipe shall be manufactured with three equally spaced pairs of blue stripes.

905.02 DUCTILE IRON PIPE AND FITTINGS – WATER MAINS.

902.02.01 Applicable Standards.

1. Cement-Mortar Lining for Ductile-Iron Pipe and Fittings: ANSI/AWWA C104
2. Polyethylene Encasement for Ductile-Iron Pipe Systems: ANSI/AWWA C105
3. Ductile-Iron and Gray-Iron Fittings: ANSI/AWWA C110
4. Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings: ANSI/AWWA C111
5. Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges: ANSI/AWWA C115
6. Protective Fusion-Bonded Protective Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings: ANSI/AWWA C116
7. Thickness Design of Ductile-Iron Pipe: ANSI/AWWA C150
8. Ductile-Iron Pipe, Centrifugally Cast: ANSI/AWWA C151
9. Ductile-Iron Compact Fittings for Water Service: ANSI/AWWA 153
10. Installation of Ductile-Iron Water Mains and Their Appurtenances: ANSI/AWWA C600
11. Ductile-Iron Pipe and Fittings (Manual of Water Supply Practices): AWWA M41

905.02.02 Pipe.

- (a) Pipe shall conform to the City of Baltimore Department of Public Works *Specifications for Materials, Highways, Bridges, Utilities, and Incidental Structures*, dated 2006 (and subsequent amendments) except as modified herein. Pipe shall be in accordance with all the requirements of ANSI/AWWA C151/A21.51 except that the

metal thickness shall be as tabulated herein or increased as required. Pipe nominal lengths shall be 18 or 20 feet.

(b) Thickness Determination

For ductile iron pipe furnished by the Contractor, the following table shall be used:

3 in.	54	.34	3.96	350 psi
4 in.	54*	.35	4.80	350 psi
6 in.	54*	.37	6.90	350 psi
8 in.	54*	.39	9.05	350 psi
10 in.	54*	.41	11.10	350 psi
12 in.	54*	.43	13.20	350 psi
16 in.	54*	.46	17.40	350 psi
20 in.	54*	.48	21.60	350 psi
24 in.	54*	.50	25.80	350 psi
30 in.	54	.55	32.00	300 psi
36 in.	54	.63	38.30	300 psi
42 in.	54	.71	44.50	300 psi
48 in.	54	.79	50.80	300 psi

* For 4-inch to 24-inch pipe requiring grooved joints, pipe furnished shall be Thickness Class 56.

** Laying Condition B is defined as pipe laid on flat-bottom trench, backfill tamped.

- (c) All pipe and fittings shall be designed and constructed to withstand all external pressure caused by overburden indicated on the profile, traffic loads or any other loads to which the pipe may be subjected. Thickness shall be increased if required due to a change in laying condition or due to excessive cover. Design thickness shall be determined from ANSI/AWWA C150/A21.50; however, in no case shall wall thickness furnished be less than required in the table above.
- (d) All pipe and fittings 16-inches in diameter or larger (except insulating flanges) shall have joints electrically bonded utilizing a minimum of two (2) bond wires across each joint. In addition, pipe and fittings less than 16-inch in diameter shall have joints electrically bonded where required by individual Contract Documents.
- (e) Unless indicated otherwise by individual Contract Documents, for the following lengths of each pipe diameter 14 inches and larger required per Contract, furnish “gauged full length” pipe in the following minimum quantities:

2 – 200 ft.:	furnish one (1) length “gauged full length” pipe
201 – 1333 ft.:	furnish two (2) lengths “gauged full length” pipe
over 1333 ft.:	furnish three-percent (3%) of pipe as “gauged full length” pipe, rounded up to next whole length

“Gauged full length” pipe shall be utilized where it is known that field cuts will be required.

- (f) All pipe and fittings shall be furnished complete with all joining materials.

905.02.03 Fittings.

All fittings shall be in accordance with the latest standards of the Baltimore City Department of Public Works and with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. They shall be designed and constructed to withstand a pressure not less than that for the adjacent pipe. Gray iron fittings may be substituted if ductile iron fittings are not available. Fittings 24 inches and smaller shall have a pressure rating of 350 psi. Fittings 30 inches to 48 inches shall have a pressure rating of 250 psi. Consult the Design Division of the Bureau of Engineering and Construction for acceptable pressure ratings for fittings greater than 48 inches.

905.02.04 Lining and Coating.

(a) General Pipe and Fittings.

All general pipe and fittings shall be cement-lined, double thickness. This lining shall be sealed with a bituminous seal coat. The outside surface shall be bituminous coated. Cement lining and seal coat shall be in accordance with ANSI/AWWA C104/A21.4. Outside coating shall be in accordance with ANSI/AWWA C151/A21.51.

1. Subject to approval by the Design Division, epoxy coatings on interior and exterior surfaces may be substituted for use on fittings only; see item (b) below for requirements.
2. When required by the Contract Documents, provide zinc-based coating on exterior of pipe and fittings. The zinc coating system shall conform to ISO 8179-1:2017, *Ductile iron pipes, fittings, accessories and their joints—External zinc-based coating—Part 1: Metallic zinc with finishing layer*. Metallic zinc-based coating shall be applied to the external surface of the pipeline component such that the mean mass of zinc-based coating is not less than 0.655 oz/sq.ft. with no local minimum less than 0.590 oz/sq.ft.. Finishing layer shall be a bituminous topcoat with a minimum average dry film thickness of 3 mils with no local thickness less than 2 mils.

Zinc coating that has been damaged but deemed repairable by the Engineer shall be repaired using an application of zinc-rich paint. Paint used for such repair shall be in accordance with ISO 8179 requirements and shall contain more than 85-percent zinc, by mass, in the dried film. See the Approved Source of Supply for acceptable paint manufacturers.

(b) Miscellaneous Fittings.

Miscellaneous fittings such as sleeves shall be furnished with a fusion-bonded epoxy coating on all interior and exterior surfaces. Fusion-bonded epoxy coatings shall be in accordance with ANSI/AWWA C116/A21.16 and shall be six to eight mil (6-8) in thickness, or as recommended by the manufacturer of the fitting.

905.02.05 Joints, Non-Restrained.

Pipes shall have mechanical joints or rubber gasket push-type joints. Fittings shall have mechanical joints only. All joints shall be in accordance with ANSI/AWWA C111/A21.11.

The maximum permissible deflection for pipelines 4 inches to 24 inches in diameter is given on Standard Detail Plate W-7.

905.02.06 Joints, Restrained.

- (a) Restrained joints shall be used in those sections shown on the Contract Drawings or shown in the *Standard Details for Construction*. Only those listed in the approved *Source of Supply* or approved by the Engineer shall be used. In cases where approval is required, the Contractor shall submit to the Engineer five (5) copies of the catalog cut along with pull-out strength data. If the Contractor requests restrained joints in lieu of another type of restraint system, he shall submit calculations for the restrained length of pipe in accordance with the guidelines set forth by DIPRA (Ductile Iron Pipe Research Association).
- (b) Restrained fittings shall have mechanical joint bells only.
- (c) Joint Type and Applications

Table 905.02.05 Restrained Joints				
Type	Material	Restraint Mechanism	Working Pressure	Uses and Restrictions
Set Screw Retainer Glands	A-536 Ductile Iron	Hardened Steel Set Screws with knurled & cupped points and torque-limiting twist off nuts.	-	<ol style="list-style-type: none"> 1. Split ring retaining glands not for use on new construction. 2. Not for connection of DIP to existing CIP. 3. Use only in areas of no settlement. 4. Use only at pipe or fittings installed \leq 160 feet.
Wedge Action Retainer Glands	A-536 Ductile Iron	Ductile Iron Wedges with heat-treated set screws with torque-limiting twist-off nuts. Restraint mechanism places multiple wedging action against pipe.	4" - 16" Pipe: 350 psi 20" - 48" Pipe: 250 psi 2:1 safety factor	<ol style="list-style-type: none"> 1. Used to retain plain end DIP to pipe or fittings with mechanical joint bells per ANSI/AWWA C 111/A21.11 2. Joint flexibility to be retained following burial. 3. May be used on CIP if sound & of same outer diameter as DIP. 4. Split ring retaining glands not for use on new construction. 5. Approved for use when: <ol style="list-style-type: none"> a. Straight pipe, \leq160 LF with areas of no settlement. b. Fittings - Inflexible (no settlement) or Semi-flexible (fill or bad soils).
Push-Type with Welded-On Lock Rings		Integral cast restraint joint bell, a spigot end with factory welded alloy steel lock ring & proprietary ductile iron restraining ring or locking segments.	4" - 24" Pipe: 350 psi 30" - 48" Pipe: 250 psi >48" Pipe: Consult Engineer.	<ol style="list-style-type: none"> 1. Used for positive locking of joints on straight pipe. 2. Field-welded steel lock rings are not permitted. 3. Approved for use on straight pipe, short or long runs, inflexible or semi-flexible conditions.
Push-Type with Integral Restraint Gaskets		Bottleless restrained joint system for use with conventional push-on joint pipe. Locking segments to be vulcanized into rubber gasket, & shall be of corrosion-resistant hardened stainless steel.	350 psi 2:1 safety factor	<ol style="list-style-type: none"> 1. Not for use with cast iron pipe (CIP). 2. Gasket from disassembled joint shall not be reinstalled. Use a new gasket. 3. Approved for use only on straight pipe, short or long runs, with areas of little or no settlement (non-fill areas only).
Fifteen Degree (15°) Deflection Ball & Socket Restrained Joints	Pipe: ANSI/AWWA C151/A21.51 Socket: A-536 Ductile Iron	Consist of spherical socket, spherical ball, a gasket & proprietary locking system, with extra metal thickness at juncture of ball & pipe barrel.		<ol style="list-style-type: none"> 1. Used in subaqueous applications where variable joint deflections are needed. 2. Deflection of pipelines limited to 12° cumulative horizontal & vertical. Laying schedule to reflect this deflection limit.
Flanged Joints	Pipe: ANSI/AWWA C115/A21.15 except min. wall thickness equal to Class 54. Flange per ASME/ANSI B16.1, Class 125*. Gaskets full-faced.	Bolted connections providing no deflection for installation in vaults or structures per Plans or Std. Details.		<ol style="list-style-type: none"> 1. Shall not be direct buried except with Engineer approval. 2. Used for installation in vaults and structures per Contract Documents and Std. Details.
Flanged Joint Adapters	A-536 Ductile Iron (Gripping wedges or set screws made of ductile iron or steel.) Flange per ASME/ANSI B16.1, Class 125*.	Multiple of individually activated gripping wedges or set screws to maximize restraint capability.	3" - 12" Pipe: 250 psi 14" - 24" Pipe: 150 psi 2:1 safety factor	<ol style="list-style-type: none"> 1. Used for adapting and restraining a plain end of DIP to a flange. (e.g. in large meter vaults for installation of flanged bypass gate valves.) 2. Shall be installed in vaults or structures per Contract Drawings or Std. Details. 3. Shall not be direct buried. 4. Not for use on plain end mechanical joint fittings. 5. Deflection limited to initial installation within manufacturer's guidelines. No additional deflection is allowed after initial installation.
Grooved Joints	ANSI/AWWA C606 Housing: A-536, Grade 65-45-12. Minimum DIP wall thickness prior to grooving: Thickness Class 56.	Plain end DIP with circumferentially cut grooves coupled together with curved housing sections with integral keys, multiple connecting bolts & nuts, and proprietary gaskets formulated for water service.		<ol style="list-style-type: none"> 1. Used in vaults & structures to restrain two sections of DIP where future disassembly is anticipated. 2. All grooved joints shall be the "flexible" type unless indicated otherwise. 3. Grooved joints shall not be direct buried.

* unless indicated otherwise in Contract Documents.

905.02.07 Couplings.

- (a) All couplings shall be manufactured in accordance with AWWA C219, Bolted, Sleeve-Type Couplings for Plain-End Pipe, except as modified by these Standard Specifications.
- (b) These Standard Specifications cover coupling sizes 4-inches through 24-inches. Consult the Design Division of the Bureau of Engineering and Construction for couplings with a diameter greater than 24 inches.

- (c) All couplings shall be rated for a minimum working pressure of 230 psig and shall be rated for a minimum test pressure of 345 psig.
- (d) Couplings shall be manufactured from carbon steel, stainless steel, or ductile iron and are intended for use in potable water systems only.
- (e) All nuts and bolts shall be either be either high strength low alloy steel with a baked-on fluoropolymer coating containing PTFE, or zinc-plated high strength low alloy steel with a Xylan 1424 (PTFE) coating. ANSI 304 stainless steel bolts and tie rods with ANSI 316 stainless steel nuts is optional. Bolts and nuts shall be a minimum 0.50-inch diameter in size.
- (f) Gaskets shall be of the hydraulically assisted type, compounded with an EPDM or Buna-N material, suitable for potable water. Gaskets shall be molded as an integral component of the coupling and shall be circumferentially ribbed to prevent "roll over" and to ensure a watertight seal on any combination of new, pitted, or corroded pipe surfaces.
- (g) Couplings shall be coated both internally and externally with NSF-61 approved fusion-bonded epoxy coatings, or Rilsan nylon, conforming to AWWA C116 (for ductile iron) or AWWA C213 (for carbon steel).
- (h) All couplings shall be of the "stab-fit" design without the need to dismantle the coupling.
- (i) Shop drawings shall be submitted to the Engineer for approval and shall include the following: dimensions, manufacturer's name and model number, weight, working and test pressure ratings, and installation instructions.

Where couplings are used to connect new ductile iron pipe to existing pipe, the Contractor shall be responsible for verifying the outer diameter of the existing pipe before ordering to ensure the proper size coupling is provided.

905.02.08 Accessories.

- (a) *Tie Rods, Nuts, and Bolts*
 1. Rods for tie rod assemblies shall meet the material requirements of ASTM A193, Grade B7, and shall be threaded for at least eight inches (8") on both ends. Rods shall be three-quarters of an inch (3/4") in diameter unless otherwise noted. Nuts shall meet the requirements of ASTM A194, Grade 2H. Manufactured tie rods and appurtenances shall result in the completed restrained joint assembly having a minimum working pressure rating of two hundred (200) psi.
 2. Bolts and studs for strapping and harnessed joints shall be minimum three-quarters of an inch (3/4") in diameter and shall meet requirements of ASTM A307.

3. Shapes, plates, and bars for strapping and harnessed joints shall meet requirements of ASTM A588.
4. All nuts and bolts and harness tie rods shall be either high strength low alloy steel with a baked-on fluoropolymer coating containing PTFE, or zinc-plated high strength low alloy steel with a Xylan 1424 (PTFE) coating.
 - a. Optional: ANSI 304 stainless steel bolts and tie rods with ANSI 316 stainless steel nuts
5. T-head bolts, harness tie rods, coupling bolts, flanged joint bolts, etc. shall be designed to provide at least one (1) complete thread projecting beyond the nut when properly tightened. Any such threaded unit that fails to meet this requirement shall be replaced at no additional cost to Baltimore County.
6. NOTE: Tie rod assemblies are no longer acceptable for use at fire hydrant settings.

(b) Wire For Bonded Joints

1. Wire for bonded joints shall be single conductor, stranded copper with high molecular weight polyethylene (HMWPE) insulation (black).
2. Wire size shall be AWG No. 2 for piping and fittings larger than thirty-six inches (36") in diameter, AWG No. 4 for piping and fittings sixteen inches (16") to thirty-six inches (36") in diameter, and (where required) AWG No. 6 for piping and fittings twelve inches (12") in diameter and smaller.

905.02.09 Polyethylene Encasement for Ductile Iron Pipe

- (a)** When required by the Contract Documents, provide polyethylene encasement for ductile iron pipe and for ductile/gray iron fittings. Polyethylene encasement shall meet all the requirements of ANSI/AWWA C105. Additionally, polyethylene encasement for use with ductile iron pipe systems shall consist of three (3) layers of co-extruded Linear Low Density Polyethylene (LLDPE), fused into a single thickness of not less than eight (8) mils.
- (b)** The inside surface of all polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of an antimicrobial biocide (to mitigate microbiologically influenced corrosion) and a volatile corrosion inhibitor (to control galvanic corrosion).

905.03 Steel Pipe – Water Mains.

905.03.01 General.

Steel pipe for water mains shall be furnished by Contractors in accordance with Special Provisions provided as part of Contract Documents for Contracts requiring use of this material. Contractors shall install steel pipe of the sizes and in the locations as shown on the Contract Drawings and as described in the Contract Specifications.

905.03.02 Applicable Standards.

1. Steel Water Pipe, 6 inches and Larger: ANSI/AWWA C200
2. Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and Larger-Shop Applied: ANSI/AWWA C205
3. Field Welding of Steel Water Pipe: ANSI/AWWA C206
4. Steel Pipe Flanges for Waterworks Service, 4 inches Through 144 inches: ANSI/AWWA C207
5. Dimensions for Fabricated Steel Water Pipe Fittings: ANSI/AWWA C208
6. Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines: ANSI/AWWA C209
7. Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines: ANSI/AWWA C210
8. Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines: ANSI/AWWA C213
9. Tape Coating Systems for the Exterior of Steel Water Pipelines: ANSI/AWWA C214
10. Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines: ANSI/AWWA C215
11. Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings: ANSI/AWWA C222
12. Steel Water Pipe: A Guide for Design and Installation (Manual of Water Supply Practices): AWWA M11
13. Cement Mortar Lining of Water Pipelines in Place – 4-Inch and Larger: ANSI/AWWA C602

905.04 Prestressed Concrete Cylinder Pressure (PCCP) Pipe – Water Mains.

905.04.01 General.

Prestressed concrete cylinder pressure (PCCP) pipe for water mains shall be furnished by Contractors in accordance with Special Provisions provided as part of Contract Documents for Contracts requiring use of this material. Contractors shall install (PCCP) pipe of the sizes and in the locations as shown on the Contract Drawings and as described in the Contract Specifications. Tapping Sleeves for Prestressed Concrete Cylinder Pipe shall be installed in accordance with Special Provisions contained in the Contract Documents.

905.04.02 Applicable Standards.

1. Prestressed Concrete Pressure Pipe, Steel-Cylinder Type: ANSI/AWWA C301
2. Design of Prestressed Concrete Cylinder Pipe: ANSI/AWWA C304
3. Concrete Pressure Pipe (Manual of Water Supply Practices): AWWA M9
4. Steel Pipe Flanges for Waterworks Service – Sizes 4-Inches through 144-Inches: ANSI/AWWA C207

905.05 High-Density Polyethylene Pipe and Fittings (HDPE) – Water Mains.

905.05.01 General.

High-density polyethylene (HDPE) pipe and fittings for water mains shall be used only when and as directed by the Design Division of the Bureau of Engineering and Construction. When so approved for use, HDPE pipe and fittings shall be furnished by Contractors in accordance with Special Provisions provided as part of Contract Documents for Contracts requiring use of this material. Contractors shall install HDPE pipe of the sizes and in the locations as shown on the Contract Drawings and as described in the Contract Specifications.

905.05.02 Applicable Standards.

Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 63 In., for Water Distribution and Transmission: ANSI/AWWA C906.

905.06 RESERVED.

905.07 Fire Hydrants, Water Valves, Water Meters, Appurtenances and Accessories.

905.07.01 General. All water meter settings, corporation stops, service saddles, fittings of 2” diameter or less and miscellaneous appurtenances of 2” diameter or less shall be “lead-free” as defined in Code of Maryland Regulation (COMAR) 09.20.01.03.

905.07.02 Fire Hydrants.

- (a) **Approved Models:** Only fire hydrants approved by Baltimore City Department of Public Works are accepted.
- (b) **Hydrant Design: Hydrant barrel** shall be a traffic model made in two sections with the flange or adjusting feature located approximately 2 inches above the ground line. The **main valve stem** shall be made in two sections with a breakaway coupling. There shall be a minimum of eight nuts and bolts connecting the upper barrel and the lower barrel at the traffic/safety flange.
- (c) **Operating Nut and Cap Nuts:** Operating nuts shall be pentagonally shaped, measuring 1-7/16 inches from the point to the flat on the top surface. To open the hydrant, the nut shall turn counter-clockwise. The direction of the opening shall be shown on the bonnet with a raised arrow.
- (d) **Elbow:** The elbow shall be ductile iron or cast iron ASTM A-126, Class B, standard 6-inch mechanical joint on the inlet end and a flanged connection on the standpipe end.

- (e) **Lower Standpipe:** Lower standpipe shall be made of ductile iron or cast iron ASTM A-126, Class B.
- (f) **Hose Connections:** There shall be one 4.5-inch pumper connection with Baltimore City Standard Threads as shown on Standard Detail Plate W-3B and two 2.5-inch hose connections with National Standard Threads.
- (g) **Valve Opening:** The main valve opening of the hydrant shall be not less than 5.25 inches.
- (h) **Bury:** The depth of bury is defined as the distance measured from the base of the elbow to the ground line (bury line) set by the manufacturer. Hydrants shall be furnished to a 5-foot bury unless noted otherwise on the Contract Drawings.
- (i) **Manufacturer's origin** shall be cast into the bonnet or upper barrel of the fire hydrant.
- (j) **Coating Requirements:** All fire hydrants to be incorporated into the Metropolitan Water System in Baltimore County shall be furnished with one of the following coating systems:

Fire Hydrant Coating Systems			
	System 1	System 2	System 3
Exterior Ferrous, Above Bury Line			
Primer	High-build Epoxy, 1 coat @ 4.0 - 6.0 mils dft	Electro-deposition (E-coat) Epoxy, 1 coat @ 0.5 – 1.0 mils dft	Heat-fused powder Epoxy, 1 coat @ 5.0 - 6.0 mils dft
Top Coat	Polyurethane enamel, 2 coats @ 1.2 – 2.0 mils dft per coat	Two-component (2K) aliphatic polyurethane, 1 coat at 1.5 – 3.0 mils dft	Heat-fused powder polyester, 1 coat @ 6.0 mils dft
Total Minimum dft	6.4 - 10.0 mils	2.5 mils	11.0 mils
Top Coat Color	Caution Orange	Caution Orange	Caution Orange
Exterior Ferrous, Below Bury Line			
Primer	N/A	Asphalt, 1 coat @1.5 – 3.0 mils dft	Asphalt, 1 coat @1.0 – 3.0 mils dft
Top Coat	High-build Epoxy, 1 coat @ 4.0 - 6.0 mils dft	Asphalt, 1 coat @1.5 – 3.0 mils dft	Asphalt, 1 coat @1.0 – 3.0 mils dft
Total Minimum dft	4.0 – 6.0 mils	2.0 mils	2.0 mils
Interior Ferrous, Elbow (Shoe), & Bottom Plate			
Primer	High-build Epoxy, NSF 61 & AWWA C550 certified, 1 coat @ 4.0 - 6.0 mils dft	Fusion bonded powder Epoxy, NSF 61 & AWWA C550 certified, 1 coat @ 4.0 – 12.0 mils dft	Heat-fused powder Epoxy, NSF 61 & AWWA C550 certified, 1 coat @ 8.0 – 10.0 mils dft

Fire Hydrant Coating Systems			
	System 1	System 2	System 3
Top Coat	High-build Epoxy, NSF 61 & AWWA C550 certified, 1 coat @ 4.0 - 6.0 mils dft		
Total Minimum dft	8.0 - 12.0 mils		

Surface Preparation: Prepare surfaces to be coated with near white metal blast cleaning in accordance with NACE No.2/SSPC-SP10.

- (k) Testing: All fire hydrants shall be shop tested in accordance with AWWA Specification C502.
- (l) Certificate of Compliance:
1. The manufacturer shall provide an affidavit certifying that all fire hydrants comply with the construction requirements of Baltimore City and that all fire hydrants comply with the coating requirements of Baltimore County (note: affidavit to indicate Coating System No. furnished).
 2. Submit certifications of compliance to the Engineer before delivery of fire hydrants.
- (m) **Hydrant Tee:** To facilitate vertical setting of hydrant valve and hydrant in sloping terrain, or to facilitate installation where a compact installation is either required or preferred, hydrant isolation gate valve (MJxMJ) may be close-coupled to service main utilizing a hydrant tee. Hydrant tee shall be ductile iron compact fitting rated for 350 psi working pressure and shall be manufactured in accordance with AWWA C153. Hydrant tee lining shall be NSF61 certified. Branch end of hydrant tee shall be plain end with ductile iron rotatable (swivel) mechanical joint gland.

905.07.03 Water Valves and Tapping Sleeves.

- (a) Requirements: Valves and appurtenances shall conform to the specifications and requirements of the Department of Public Works of **Baltimore City** except as modified herein.

Water Valves		
	Resilient Seat Gate Valves	Rubber-Seated Butterfly Valves**
Applicable Valve Sizes	4" – 24" Diameter	30" – 72" Diameter
Rating	250 psig working pressure	250 psig differential operating pressure
Installation	16" – 24" diameter shall be installed with valve bonnet oriented horizontally or vertically per Contract Drawings	Installation in Cast-In-Place vaults sized per plans. Provide one pipeline access assembly adjacent to butterfly valve for access to adjust valve seat. Provide valve overtorque protectors and valve actuators per Baltimore City requirements.

Water Valves		
	Resilient Seat Gate Valves	Rubber-Seated Butterfly Valves**
Operation	Clockwise turning to open.	Clockwise turning to open.
Valve gearing	Per Baltimore City requirements.	-
Handwheels / Operating Nuts / Position Indicator	AWWA Operating Nuts EXCEPT: (a) large meter setting valves (for meters 3" & above) (b) dewatering valves (c) manual air release valves. (d) valves attached to companion flanges at pipeline access assemblies.	AWWA Operating Nuts Provide position indicator on valve actuator
Use as Tapping Valves	Waterway inside diameter shall be ¼" greater than shell cutter. Consult Design Division of BCBECE for applications requiring gate valves in sizes larger than 24" diameter.	-
Bypass	Required only per specific Contract requirements.	-

**Field Certification: Following installation, butterfly valves and operators shall be furnished with a manufacturer's certificate stating that the valves and operators have been installed in accordance with the manufacturer's recommendations, that they have been adjusted and initially operated from the fully closed position to the fully open position and back (minimum of two full cycles) in the presence of the manufacturer's field representative, and that they are operating in accordance with the specific Contract requirements and these Standard Specifications. The manufacturer's field representative shall be a representative from the manufacturer's plant familiar with the actual problems of manufacturing, installing, adjusting, and operating the valves and operators with enough years of experience to determine the successful operation of the valves and operators. The cost for providing a manufacturer's certificate shall be included in the Contract price to provide the butterfly valves and operators.

(b) Joints: Approved joints for valves are as follows:

Approved Joints for Valves		
	Resilient Seat Gate Valves	Rubber-Seated Butterfly Valves
Flanged	ANSI B16.1 – Class 125#	ANSI B16.1 – Class 125# or Class 250# as approved by Engineer, all sizes
Mechanical Joint	AWWA C111	AWWA C111, size 30 inch through 48 inch only
Flanged x Mech. Joint	Tapping Valves Only	-

(c) Tapping Sleeves and Valves:

1. Tapping sleeves for cast iron or ductile iron pipe shall be either the ductile iron body, mechanical joint type; the stainless steel body, full circumferential band type; or the epoxy-coated fabricated steel type. Outlets shall be flanged, shall have recess dimensions in accordance with Manufacturer's Standardization Society Standard Practice SP-60, and shall be fully compatible with tapping valve.

Tapping sleeves shall be furnished with a tapped outlet for testing, complete with ¾-inch standard brass or Type 304 stainless steel square head closure plug.

2. Shop drawings shall be submitted to the Engineer for approval and shall include the following: dimensions, manufacturer's name and model number, weight, working and test pressure ratings, and installation instructions. Contractor shall be responsible for verifying the outer diameter of the pipe before ordering to ensure the proper size sleeve is provided.
3. Unless approved otherwise by the Engineer, gate valves used for tapping shall have flanged x mechanical joint end connections.
 - a. Ductile iron body mechanical joint tapping sleeves shall be rated for a working pressure of 200 psi. Bolts and nuts shall be high-strength, low-alloy steel per AWWA C111; gaskets shall be rubber. All parts in contact with potable water shall be NSF61 certified.
 - b. Stainless steel body full circumferential band tapping sleeves shall be rated for a working pressure of 150 psi. Body, flanged outlet, and flange shall be manufactured from Type 304 stainless steel. Bolts, nuts, and washers shall be manufactured from Type 304 stainless steel; bolts and nuts shall be coated to prevent galling. Sleeve outlet side and sleeve plain side shall be manufactured with triangular sidebars and joined using removable trackhead bolts; lifter bar style sleeves with studs are not acceptable. Gaskets shall be SBR or Buna-N, compounded for water service and shall be NSF61 certified. Body sleeve gasket shall provide full 360-degree contact with the pipe.
 - c. Epoxy-coated fabricated steel tapping sleeves shall be rated for a working pressure of 150 psi. Body, flanged outlet and flange shall be manufactured from A-36 carbon steel. Bolts, nuts and washers shall be manufactured from Type 304 stainless steel. Bolts and nuts shall be coated to prevent galling. Sleeves shall be lined and coated with 8 to 12 mils fused epoxy. Gaskets shall be SBR or Buna-N, compounded for water service and shall be NSF 61 certified.

(d) Valve Appurtenances:

1. **Pitometer Corporations:** All in-line (non-tapping) gate valves, 16 inches in diameter or greater, and all butterfly valves shall have 1-inch diameter corporations installed on each side of the valve for use with pitometers. Corporations shall be full-ported ball valve type rated for 300 psig working pressure, shall have AWWA taper thread inlet, and shall have increased male iron pipe thread outlet with inside driving threads. Provide bronze threaded cap on outlet.
2. **Pipeline Monitoring Corporations:** All butterfly valves installed in conjunction with prestressed concrete cylinder pipe (PCCP) shall have 1.5-inch diameter corporations installed on each side of the valve for use with pipeline monitoring equipment.

Corporations shall be full-ported ball valve type rated for 300 psig working pressure and shall have an AWWA taper thread inlet with a male iron pipe thread

outlet. Provide bronze threaded cap on outlet if corporation is not initially used for installation of pipeline monitoring equipment.

3. Pipeline Access Assemblies:

- a. All butterfly valve vaults shall be provided with pipeline assemblies that provide access for seat adjustment and pipeline maintenance/assessment. Pipeline access assemblies shall be installed immediately adjacent to the valve and shall include the following:
 - 1) 24-inch flanged outlet tee, oriented vertically
 - 2) 24" x 6" companion flange
 - 3) Four ½-inch diameter steel bars welded at 90-degree intervals around the 24-inch flange
 - 4) Two 5/8-inch diameter steel pulling irons installed on vault walls below top slab, centered over 24-inch flanged outlet
 - 5) 6-inch resilient-seated gate valve, flanged by flanged with handwheel operator, mounted to companion flange for vertical (upward) flow through valve
 - 6) 6-inch blind flange mounted to top end of resilient-seated gate valve, drilled and tapped for 1-inch diameter corporation. Provide 1-inch ball valve type corporation rated for 300 psig with MNPT inlet and MNPT outlet
 - 7) Two 1-inch diameter full-ported ball valve type pitometer corporations and 1/8-bend couplings installed outboard of butterfly valve and outboard of 24-inch flanged outlet tee. See Section 905.07.03(d), item 1
 - 8) 30-inch frame and cover with corresponding opening in top slab and brickwork, centered over flanged outlet.
- b. For pipeline access assemblies installed in conjunction with prestressed concrete cylinder pipe (PCCP), also provide two pipeline monitoring corporations as described in Section 905.07.03(d), item 2. The pipeline monitoring corporations shall be installed on flanged outlet tees to be provided and shall be placed outboard from all other appurtenances.

4. Valve Extension Stem and Stem Guides: Where the depth of a butterfly valve or gate valve (including bypass valve, if so equipped) is such that the operating nut is more than 5 feet below the valve cover surface, a valve extension stem shall be provided to bring the operating nut to a point within 18 inches (below) of the valve cover surface.

- a. Valve extension stems shall be of a solid design (no intermediate couplings), 1.25-inch square or round, manufactured from galvanized Schedule 80 steel capable of transferring a torque of 450 foot-pounds without damage. A 2-inch female socket coupling shall be provided at the lower end of the stem, and the coupling shall be pinned to the valve operating nut. A 2-inch AWWA operating nut shall be provided at the upper end of the stem.
- b. Provide adjustable stem guides, with brackets, at 7-foot intervals along extension stems. Stem guides and brackets shall be manufactured from ductile

iron. Guide blocks shall be bronze bushed where they come into contact with extension stems.

- c. For applications where valve extension stems extend into or through valve vault top slabs, support extension stems at top slabs by providing alignment washers or bushing-type floor boxes installed integral with the top slabs.
5. Special Castings: Valve vaults, frames and covers or other special castings and other materials must be of the sizes, patterns, and materials shown on the Standard Detail Plates or as directed by the Engineer.

905.07.04 Water Meter Settings, Corporation Stops, and Service Saddles.

(a) Water Meter Settings and Corporation Stops

Water Meter Settings & Corporation Stops			
	Standard Detail Plate	Rating	Description
3/4" – 1" Supply Lines	W-21, W-22,W-23, W-28A, B	300 psig	Corporation stops with flared copper coupling at main. Stop shall be ball valve type corporation with an AWWA taper-thread inlet. For W-28A, B: eighth bend service fitting, female copper thread x flare copper may be utilized to facilitate installation in vault.
3/4" – 1" Supply Lines - connect to Blind Flange	City Details	300 psig	Corporation stops shall be a ball valve type corporation with a male iron pipe (MIP) thread inlet with flared copper coupling nut outlet.
1 1/2" – 2" Supply Lines	W-24, 24A, W-25, 26, W-26A, W-28A and B, W-32, 33	300 psig	Corporation stops shall be ball valve type corporation with an AWWA taper-thread inlet with CTS (copper tube size) compression outlet. For W-28A, B: (1) Eighth bend service fitting, female copper thread x female copper thread may be utilized to facilitate vault installation. (2) Provide appropriate 90 degree (ell) coupling to continue meter setting connection.
1 1/2" – 2" Supply Lines - connect to Blind Flange	City Details	300 psig	Corporation stops shall be ball valve type corporation with a male iron pipe (MIP) thread inlet with male iron pipe (MIP) thread outlet.

1. **Insulating Corporation Stops:** Insulating corporation stops for service connections 3/4-inch to 2 inches in diameter shall be provided where required by specific Contract requirements to prevent the flow of stray electrical currents.
 - a. Insulating corporation stop shall consist of a ball valve type corporation with AWWA/CC taper thread inlet, inert service insulator, and either flare copper nut outlet (3/4-inch and 1-inch) or CTS (copper tube size) compression outlet (1.5-inch and 2.0-inch).
 - b. The nylon insulator shall have high dielectric, compressive, and impact strength. The insulator skirt shall be extra long to resist electrical bridging or shorting.
 - c. O-ring seal, when required by individual manufacturers, shall be retained in a groove to prevent O-ring loss if tailpiece (outlet) is removed.

- d. Factory-assembled insulating corporation stop assemblies shall be furnished whenever possible.
2. **Meter Yokes** (5/8-inch meters, 3/4-inch meters, 1-inch meters): Meter yokes shall conform to Baltimore City requirements. They shall be manufactured from cast iron and have a corrosion-resistant finish of either epoxy powder coating or black E-coating (Powercron 590). They shall be furnished with ends suitable to connect angle yoke ball valves and shall have support lips to hold water meter and expansion connection. NOTE: Expansion connection and water meter shall be furnished by Baltimore City.

All domestic water services (5/8-inch to 2-inch meters) shall be furnished with full-port angle yoke ball valves on both the inlet and outlet side of the meter.

Meter yokes for twin meters shall be provided with a yoke bar spacer (tie bar) of appropriate length, firmly attached to each yoke bar.
3. **Field-Assembled Meter Settings:** Field-assembled meter settings are as shown on **Standard Detail Plates W-21, W-22, and W-23**; and include as appropriate single 5/8-inch meters and single 3/4-inch meters on **Standard Detail Plates W-28A and W-28B**.
4. **Factory-Assembled Meter Settings:** Factory-assembled meter settings are as shown on **Standard Detail Plates W-24, W-24A, W-25, W-26, W-26A, W-32, and W-33**; and include, as appropriate, single 1-inch meters, single 1.5-inch meters, and single 2-inch meters, on **Standard Detail Plates W-28A and W-28B**.
 - a. Due to the number of fittings required and the use of soldered joints, field-assembly of these meter settings is not permitted.
 - i. Factory-assembled meter settings require approval from the Design Division of the Bureau of Engineering and Construction.
 - ii. Settings shall be pressure tested to 150 psig.
 - iii. Soldered joints shall be lead free.
 - b. All meter settings shall be furnished with horizontal inlet and outlet(s) equipped with FIP threads.
 - c. All inlet and outlet tees shall be furnished with brace eye supports. Inlet and outlet tees shall function as elbows; tees shall not be drilled for by-pass flow.
 - d. All single-yoke meter settings and all single-flanged meter settings shall be furnished with tie bar tube connecting closed (undrilled) port of inlet tee to closed (undrilled) port of outlet tee. The tie bar tube shall connect to one (or both) tee(s) with a compression coupling.
 - e. Meter settings shall be constructed from “no-lead” brass and Type K copper tubing.
5. **Fittings:** Fittings shall be of the size and type shown on the Standard Detail Plates and in accordance with the following requirements:
 - a. Connections to 3/4-inch and 1-inch Copper Tubing:
 - i. All connections to terminal ends of 3/4-inch and 1-inch copper tubing shall be made using flared connections; the use of sweated (soldered) joints to

make connections on terminal ends of ¾-inch and 1-inch copper tubing is strictly prohibited.

- ii. Male iron pipe (MIP) thread copper connections for ¾-inch and 1-inch copper tubing shall be straight couplings, copper flare nut x MIP.
 - iii. Brass connection at service end of ¾-inch and 1-inch tubing shall be copper flare x FIP.
 - iv. All service ends of ¾-inch and 1-inch copper tubing not immediately connected to house service shall be provided with brass or plastic plug (MIP thread) to prevent any foreign matter from entering into pipe.
 - v. Couplings to join adjacent ends of ¾-inch copper tubing or to join adjacent ends of 1-inch copper tubing shall be three-part union, copper flare x copper flare.
- b. Connections to 1.5-inch and 2-inch Copper Tubing:
- i. All connections to terminal ends of 1.5-inch and 2-inch copper tubing shall be made using copper compression couplings. The use of either sweated (soldered) joints or flared joints to make connection on terminal ends of 1.5-inch and 2-inch copper tubing is strictly prohibited.
 - ii. Commercial copper compression couplings shall be as listed in the approved *Source of Supply*.
 - iii. Full-size, straight, copper compression coupling x MIP thread shall be used to connect 1.5-inch and 2-inch copper tubing to the following:
 - inlet and outlet of all meter settings shown on **Standard Detail Plates W-24, W-24A, W-25, W-26, W-26A, W-32, and W-33**, or included as appropriate on **Standard Detail Plates W-28A and W-28B**.
 - threaded inlet of flanged meter ball valves (2-inch size) (for repairs to factory-assembled meter settings)
 - galvanized cap at service end
 - iv. All service ends of 1.5-inch and 2-inch copper tubing not immediately connected to house service shall be provided with galvanized cap (FIP thread) to prevent any foreign matter from entering the pipe.
 - v. Straight couplings to join adjacent ends of 1.5-inch copper tubing or to join adjacent ends of 2-inch copper tubing shall be copper compression x copper compression.
 - vi. 90-degree (ell) coupling, if required to join right-angle ends of 1.5-inch copper tubing or to join right-angle ends of 2-inch copper tubing, shall be copper compression x copper compression.
 - vii. 90-degree (ell) couplings, if required to connect 1.5-inch copper tubing to an offset (right-angle) FIP-threaded fitting or to connect 2-inch copper tubing to an offset (right-angle) FIP-threaded fitting, shall be copper compression x MIP thread.
 - viii. 90-degree (ell) couplings, if required to connect 1.5-inch copper tubing to an offset (right-angle) MIP-threaded fitting or to connect 2-inch copper tubing to an offset (right-angle) MIP-threaded fitting, shall be copper compression x FIP thread.

ix. Straight coupling, if required to connect 1.5-inch copper tubing to a 1-inch angle-yoke ball valve shall be reduced-size copper compression x MIP thread.

c. **U-Branch (Meter Spreader) Requirements for Twin Meters:**

i. U-branch for twin 5/8-inch meters, as shown in **Standard Detail Plate W-22**, shall be of “no lead” brass construction with 7.5-inch center-to-center spacing. Branch connection shall have 1-inch copper flare nut inlet and 3/4-inch MIP thread outlets.

ii. U-branch (or Y-branch) for twin 3/4-inch meters, as shown in **Standard Detail Plate W-32**, shall be of “no lead” brass or Type K copper construction with 9-inch center-to-center spacing. Branch connection shall have 1.5-inch copper compression inlet and 1-inch MIP-thread outlets.

iii. U-branch (or Y-branch) for twin 1-inch meters, as shown in **Standard Detail Plate W-33**, shall be of “no-lead” brass or Type K copper construction with 9-inch center-to-center spacing. Branch connection shall have 1.5-inch copper compression inlet and 1-inch MIP-thread outlets.

6. **Meter Vaults:**

a. Prefabricated meter vaults shall be of the size indicated on the Standard Detail Plates or as approved by the Design Division of the Bureau of Engineering and Construction.

b. Prefabricated water meter vaults shall be furnished with a standard Meter Frame and Cover, including antenna retainer bracket, as shown in the Standard Detail Plates.

c. Meter vaults for housing (single or twin) 5/8-inch, 3/4-inch, and 1-inch meters generally shall be constructed of pre-cast concrete. Subject to the approval of the Design Division of the Bureau of Engineering and Construction, meter vaults constructed from high-density polyethylene (HDPE) may be substituted for concrete meter vaults in non-traffic areas.

i. Concrete meter vaults shall have materials, wall thickness, and reinforcement in accordance with AASHTO M-170.

ii. HDPE meter vaults, when approved, shall be manufactured from heavy wall, high-density polyethylene, minimum nominal wall thickness of 1/2-inch, and shall be able to withstand a vertical freestanding load of 20,000 pounds. Meter vaults shall be of one-piece molded construction, shall have a top flange for frame and cover seating, and shall have a bottom flange for anti-settling at the base.

(b) Service Saddles for Tapping Pipe: Where shown on specific Standard Detail Plates, provide service saddles for tapping PCCP, ductile iron or cast iron pipe. Internal threads for connecting the corporation stop shall be AWWA standard threads (Type “CC”) per AWWA C 800.

Service Saddles			
Purpose	Tapping ductile iron or cast iron pipe		Tapping PCCP
Body	Brass (alloy) Body	Ductile Iron Body: Four-bolt design with nylon or epoxy coating over entire body	Body and outlet: A 536 ductile iron, fusion epoxy coated.
Straps	Double flattened silicon bronze straps	Dual or single-wide Type 304 stainless steel band(s); welds treated for add'l. corrosion resistance	Type 304 stainless steel
Hardware	Nuts: brass alloy with integral washers	Nuts & washers: Type 304 stainless steel; coat bolts (studs) & nuts to prevent galling.	Washers: A 536 ductile iron; outlet bolts: corrosion resistant, hi-strength low alloy steel
Gasket	Buna-N rubber or equal, compounded for potable water	Buna-N or EPDM, NSF 61 certified, compounded for water service	Buna-N, NSF 61 certified, compounded for water service
Applicable Requirements	ANSI/AWWA C 800		
Working pressure	200 psig	200 psig	150 psig

905.07.05 Miscellaneous Appurtenances.

(a) Corporation Stop in Air Release Valve Applications (see Standard Detail Plate W-8):

1. Corporations for connection to ductile iron pipe (sizes 4-inch to 30-inch) or PCCP (sizes 16-inch to 30-inch) shall be ball valve type rated for 300 psig working pressure, shall have AWWA taper thread inlet, and shall have female iron pipe (FIP) thread outlet.
2. Corporations for connection to 4-inch and 6-inch blind flanges (pipe diameters 36 inches and larger) shall be ball valve type rated for 300 psig working pressure, shall have male iron pipe (MIP) thread inlet, and shall have MIP thread outlet.

Provide 1/8 bend coupling, FIP thread inlet x copper flare outlet, on end of corporation.

(b) Corporation Stop in Blow-Off Valve Applications (see Standard Detail Plate W-11):

Corporations for connection to ductile iron pipe with diameters 4 inches to 12 inches shall be ball valve type rated for 300 psig working pressure, shall have AWWA taper thread inlet, and shall have female iron pipe (FIP) thread outlet.

- (c) Brass or Bronze Gate Valve with Handwheel** shall be used in air release applications for 4-inch to 30-inch pipe (see **Standard Detail Plate W-8**) and shall be used in blow-off applications for 4-inch to 12-inch pipe (see **Standard Detail Plate W-11**). Gate valve shall be manufactured from heavy-duty brass or bronze, shall be rated for 200 psig working pressure, shall be fully ported with solid wedge disc, shall

have FIP thread ends and non-rising stem, and shall be provided with iron or aluminum handwheel.

See appropriate **Standard Detail Plate (W-8 or W-11)** for size requirements.

- (d) Brass Pipe:** Provide threaded seamless brass pipe, extra strong, of appropriate length and diameter, as required by **Standard Detail Plates W-8 and W-11**.

905.07.06 Accessories.

(a) External Coating System for Insulating Flanges and Insulating Corporation Stops:

1. Insulating flanges shall receive exterior tape wrapping/coating in the field. Insulating corporation stops (including saddles) not protected by extending polyethylene encasement (see 905.02.09) or not protected with pipe wrap tape (see 905.07.06(b)) also shall receive exterior tape wrapping/coating in the field. All components of the wrapping/coating system shall be manufactured by a single supplier to assure compatibility of components. Provide System A or System B as described below.
2. System A:
 - a. Primer: A blend of microcrystalline wax, plasticizer, and corrosion inhibitors having a paste-like consistency, designed to displace moisture, penetrate rust and wet the surface, ensuring adhesion of the tape.
 - b. Filler Putty: A cold-applied anti-corrosive moldable filler material used to even the contours of irregular fittings and surfaces. The filler putty shall have the following properties:
 - i. Specific gravity: 1.15
 - ii. Density: 24 cu in/lb
 - iii. Filler putty shall be used at all irregular surfaces to provide a smooth surface for the application of the innerwrap and outerwrap.
 - c. Innerwrap: A non-woven, non-stitch bonded synthetic fabric saturated with a blend of microcrystalline wax, plasticizer, and corrosion inhibitor (no clay fillers). The inner tape shall have the following properties:
 - i. Thickness: 70 to 90 mils
 - ii. Dielectric strength: 170 volt/mil.
 - d. Outerwrap: A white, resin-coated, woven fiberglass fabric. The outerwrap shall have the following properties:
 - i. Thickness: 0.005 inch
 - ii. Tensile strength (per 1-inch width), minimum: 85 pounds
 - iii. Tape width: 6 inches
3. System B:
 - a. Primer: A primer containing moisture displacing corrosion inhibitors having the following properties:
 - i. Solids content: greater than 98-percent

- ii. Specific gravity: 1.08
 - iii. Specific volume: 26 cu in/lb
 - b. Filler Mastic: A cold-applied self-supporting molding mastic consisting of a petrolatum compound containing beads of closed-cell, cellular polymer with flow control additives. Filler mastic shall have the following properties:
 - i. Solids content: 100 percent
 - ii. Specific gravity: 0.605
 - iii. Specific volume: 45.9 cu in/lb
 - c. Innerwrap: A non-woven synthetic fabric carrier fully impregnated with a neutral compound based on saturated petrolatum and inert siliceous fillers. Innerwrap shall have the following properties:
 - i. Thickness: 46 mils
 - ii. Breaking strength: 22.5 lbf/in
 - iii. Water vapor transmission: 0.006 perms average
 - iv. Resistance to cathodic disbonding: 0.28 sq in average
 - d. Outerwrap: A plasticized polyvinyl chloride sheeting coated on one side with a rubber resin, pressure sensitive adhesive. Outerwrap shall have the following properties:
 - i. Thickness: 10 mils
 - ii. Weight: 0.07 lbs/sq. ft
 - iii. Breaking strength: 25 lbf/in
- 4. Applications:
 - a. Insulating Flanges: Coating System A or B is required for use in conjunction with all polyethylene-encased ductile iron water mains and all bonded coated water mains.
 - b. Insulating Corporation Stops (Including Saddles): Coating System A or B is required for use in conjunction with new bonded coated water mains or existing bonded coated water mains. Coating System A or B is acceptable for use in conjunction with new polyethylene-encased ductile iron water mains. Coating System A or B is not recommended for use in conjunction with existing polyethylene-encased ductile iron water mains due to the need to clean, cut and re-seal the existing encasement.

(b) Pipe Wrap Tape for Copper Supply Lines Connecting to Polyethylene-Encased Water Mains:

1. Polyethylene-encased ductile iron water mains always require the use of insulating corporation stops to prevent the flow of stray electrical currents. As an alternative to extending the polyethylene encasement (see 905.02.09) along the copper supply line or providing System A or B (see 905.07.06(a)), the Contractor may provide pipe wrap tape to wrap corporation stop, saddle, and adjoining first three (3) feet of copper supply line.

2. Pipe wrap tape shall have the following properties, as described by test methods in ASTM D-1000:
 - a. Tape thickness: 10 mils
 - b. Adhesion to steel: 20 oz/in
 - c. Adhesion to backing: 20 oz/in
 - d. Elongation at break: 200 percent
 - e. Tensile strength: 25.7 lbs/in
 - f. Dielectric strength: 1250 volts/mil
3. Applications:
 - a. Pipe wrap tape can be used at insulated copper supply line connections to new polyethylene-encased ductile iron water mains or to existing polyethylene-encased ductile iron water mains.
 - b. Pipe wrap tape is not approved for use at insulated copper supply line connections to bonded coated water mains.

SECTION 906 – GABIONS

906.01 WIRE FOR GABIONS. The wire shall have a minimum tensile strength of 60,000 psi when tested as specified in A 370. All wire sizes and mesh spacing shall be as recommended by the manufacturer. Tie and connecting wire shall also conform to this Specification.

Stainless steel interlocking fasteners may be substituted for wire ties. The fasteners shall conform to A 313. When subjected to directional tension along its axis, the fastener shall remain in a closed and locked condition for a minimum force of 900 lb.

906.01.01 Galvanized Coating for Gabions. Galvanized coating for fabric, ties, and connecting wire shall not be less than 0.8 oz/sq.ft. when tested as specified in A 90.

906.01.02 Polyvinyl Chloride (PVC) Coating for Gabions. PVC coating for fabric, ties, and connecting wires for gabions shall exhibit no weight loss when tested as specified in MSMT 508. Color shall conform to Federal Standard 595, gray color No. 26440 or green color No. 24533 and shall match throughout the project.

SECTION 907 – PILES AND PILING

907.01 TIMBER PILING. Timber piling shall conform to M 168.

907.01.01 Resin and Fiberglass Caps for Timber Pile Heads. Resin and fiberglass for use in protecting timber pile heads shall conform to the following:

PROPERTY	SPECIFICATION LIMIT	TEST METHOD
MOISTURE INSENSITIVE RESIN		
Tensile Strength, psi, min.	5000	D 638
Tensile Elongation, % min.	0.05	D 638
Compressive Strength, psi, min.	9000	C 109
Abrasive Resistance, * l/mil, min.	60	D 968
WOVEN GLASS CLOTH		
Weight, oz/sq.yd. min.	9	-
Type	Volan A	-

*liters (l) of fine aggregate per mil thickness of resin

907.02 CASINGS FOR CAST-IN-PLACE CONCRETE PILES. Steel shells or casings shall be formed from a single piece of metal having not more than one continuous welded seam. The seam shall have a yield strength of 28,000 psi minimum. Tips shall conform to A 36.

907.03 STEEL BEARING PILES. Steel bearing piles and steel bearing pile splice material shall conform to A 36.

907.04 STEEL SHEET PILES. Steel sheet piles shall conform to A 328. Sheet pile accessories shall conform to A 36. High strength bolts shall conform to the requirements given in Section 909.07.

907.05 WELDING MATERIALS. Welding materials shall conform to AASHTO/AWS D1.5.

907.06 STEEL PIPE PILES. Per A252 Grade 2.

SECTION 908 – REINFORCEMENT STEEL

908.00 CERTIFICATION. The steel manufacturer shall furnish certification for each heat of steel as specified in Section GP-1.05.

908.01 DEFORMED REINFORCEMENT. Unless otherwise specified, reinforcement bars and reinforcement bars used as anchoring devices shall be Grade 60 deformed bars per A 615 or A 706. Deformed bars shall be epoxy coated when specified. Epoxy powder shall be as specified in Section 917.02.

908.02 PLAIN REINFORCEMENT. Unless otherwise specified, dowel bars and dowel bars used as ties in Portland cement concrete pavement expansion and contraction joints shall

be plain round steel bars conforming to A 615, Grade 60 or A 36. Bars shall be epoxy coated. Epoxy powder shall conform to the requirements given in Section 917.02.

908.03 STAINLESS STEEL BARS. In lieu of epoxy coated plain bars, the Contractor may use stainless steel bars. Deformed bars shall be stainless steel when specified in the Contract Documents. Stainless steel shall conform to A 276, Type XM-29. Deformed stainless steel bars shall conform to A 615 for cross sectional area and deformations.

908.04 SLEEVES FOR DOWEL BARS IN PAVEMENT EXPANSION JOINTS. Sleeves for dowel bars shall be of sheet metal capable of sliding over $2 \pm 1/4$ in. of the dowel and shall have a closed end with a stop to hold the end of the sleeve at a minimum distance of 1 inch from the end of the dowel bar.

908.05 WELDED STEEL WIRE FABRIC. Welded steel wire fabric shall conform to M 55. Fabric used in pavement construction shall be furnished in flat sheets.

908.06 WELDED DEFORMED STEEL WIRE FABRIC. Welded deformed steel wire fabric shall conform to M 221.

908.07 FABRICATED STEEL BAR MATS. Steel shall meet A 184, Grade 60.

908.08 WIRE FABRIC FOR PNEUMATICALLY APPLIED MORTAR AND CONCRETE ENCASUREMENT. Fabric shall meet A 185 and be galvanized as specified in Section 906.01.01. Fabricate from size W1.4 wire on 3 in. centers in each direction or from W0.9 wire on 2 in. centers in each direction.

908.09 COLD DRAWN STEEL WIRE. Concrete reinforcement per M 32.

908.10 TIE DEVICES FOR CONCRETE PAVEMENT. Tie device sizes shall be as specified and produce a frictional force of at least 160 lb/ft per foot of spacing when tested per MSMT 512.

908.11 STEEL STRAND. M 203, Grade 270, Low Relaxation Strand.

908.12 STRESS RELIEVED WIRE. Stress relieved wire shall conform to M 204, Type WA.

SECTION 909 – METALS

909.00 CERTIFICATION. The metal producer shall furnish certification as specified in Section GP-1.05. The certification shall include actual mill test results. The processing manufacturer shall also furnish information regarding the chemical and physical properties of the finished metal products.

909.01 STRUCTURAL STEEL. Structural steel shall conform to the requirements specified in the Contract Documents. All primary load carrying members shall conform to the supplementary toughness requirements of M 270, Zone 2.

Primary load carrying members are as follows or as designated in the Contract Documents: Finger joint steel from which saw tooth configurations have been cut, all stringers, cover plates, bearing stiffeners, splice plates, pins and pin links for straight rolled steel beam bridges; all flanges, webs, bearing stiffeners, splice plates, pins and pin links for straight steel girder bridges. Additionally, on curved rolled steel beam and steel girder bridges; all diaphragms, cross frames, lateral bracing, including connection plates to main stringers.

909.02 STEEL FOR MISCELLANEOUS USE. Steel for miscellaneous use shall conform to A 36 or A 709, Grade 36. Steel for bearings on structures shall conform to A 709, Grade 50.

909.03 WELDING MATERIALS. Welding materials shall conform to AASHTO/AWS D1.5.

909.04 GRAY IRON CASTINGS. Iron castings for placement within Baltimore County rights-of-way or easements for drainage or utility use shall conform to the following:

1. Materials per ASTM A48, Class No. 30B, or better, unless indicated otherwise.
2. Castings shall be free of burnt-on sand, blowholes, welds and plugs. Surfaces shall be reasonably and consistently smooth. Runners, risers, fins, etc. shall be removed and the areas ground smooth. Finish to be unpainted. Presence of dirt, scab or slag requires repair, re-cleaning and re-submittal of affected castings. Pinholes, shrink or cracks in a casting are cause for rejection.
3. Bearing surfaces between frames and covers / grates shall be cast or machined with sufficient precision that uniform bearing is provided throughout the intended area of contact. Pairs of machined castings shall be match marked for identification during installation.
4. Covers and grates shall not rock within frames. Rocking may not occur when cover / grate is rotated to any position in the frame.
5. Cover / grate shall sit within frame so that top of cover / grate is flush with top of frame as shown on Standard Detail Plates. A difference of more than 1/8" at any point is unacceptable. Variation in level between cover & frame shall not exceed 1/16" in over 1/4 of circumference.
6. Tolerances shall be as noted on Standard Detail Plates or as follows:

FRAME:

Cover Opening Diameter:	+ 1/16"
Cover Opening Depth:	+ 1/32", -0"
Height:	+ 1/8"
Flange:	+ 1/4"

COVER / GRATE:

Diameter: + 1/16"
Seat Depth: + 0", -1/32"

OTHER DIMENSIONS: + 1/8"

7. Each casting provided to Baltimore County shall be prominently marked with the foundry name, country, date of manufacture, AASHTO/ASTM designation, Class and heat number by casting, engraving or stamping with 1/2" min. letters. Foundry name and country of manufacture, at a minimum, shall be visible after installation. Covers and grates shall have foundry name and country of manufacture imprinted on their top surfaces.
8. In addition to the criteria stated in items 1 through 7, acceptance of castings shall be based upon acceptable proof load tests on actual castings, per Sections 7.1 and 8.1.1 of AASHTO M 306. Test bar results shall not constitute acceptable proof of load bearing capacity for castings to be used in Baltimore County.
9. The foundry shall provide certification of results of proof load testing of samples through the supplier to Baltimore County DPW&T's Division of Construction Contracts Administration or to the Baltimore County Bureau of Utilities, or Bureau of Highways, as applicable, upon delivery to site. Certification shall be based upon random testing of each item at a minimum of once every 6 months, and/or upon on-demand testing as requested by Baltimore County. Castings for which no certification is provided, or where certification is deemed inadequate shall be rejected and removed from the site. The foundry shall maintain and make records of test results available to Baltimore County for a minimum period of 7 years.

909.05 STEEL STUD SHEAR DEVELOPERS. Shear developers shall conform to AASHTO/AWS D1.5.

909.06 BOLTS, NUTS AND WASHERS FOR GENERAL USE. Bolts, nuts and washers for general use shall conform to A 307 Grade A, and shall be galvanized as specified in A 153. Anchor bolts shall be galvanized and shall conform to A 709, Grade 36.

909.07 HIGH STRENGTH BOLTS, NUTS AND WASHERS. High strength bolts, nuts and washers shall conform to A 325.

909.07.01 Anchor Bolts for Traffic Signals, Highway Lighting, and Signs. Anchor bolts for traffic signals, highway lighting, and signs shall conform to F 1554, Grade 55 S1. Anchor bolts shall be galvanized for the full length of the threads and 3 in. below the threads in conformance with A 153. Nuts shall be hex nuts conforming to A 194, grade 2H or A 563, Grade DH. Flat washers shall be heavy washers conforming to F 436. All hardware shall be galvanized in conformance with A 153.

909.08 CAST WASHERS. Cast washers, ogee washers and special cast washers shall conform to A 47. Cast washers shall be mechanically or hot dip galvanized. The coating shall conform to the thickness, adherence and quality requirements of A 153.

909.09 HARDWARE. Spikes, wood screws, staples, brads, lag screws, carriage bolts and other parts under the general heading of HARDWARE shall be composed of carbon steel and shall conform to Federal Specification FF-N-105.

909.10 STEEL FORMS. Steel bridge deck forms and deck form supports that remain in place shall be fabricated from steel conforming to A 653, Designation SS, Grades 33 through 80, Coating Designation G 165. The minimum thickness of uncoated steel shall be 0.0359 in.

SECTION 910 – BEARINGS

910.00 CERTIFICATION. The bearing producer shall furnish certification as specified in Section GP-1.05. The certification shall include actual mill test results. The processing manufacturer shall also furnish the chemical and physical properties of the finished bearings.

910.01 BRONZE OR COPPER ALLOY BEARING AND EXPANSION PLATES. Bronze or copper alloy plates shall be either of cast bronze or rolled copper alloy.

910.01.01 Cast Bronze. Cast bronze bearing and expansion plates shall conform to B 22, Alloy No. 91100 or No. 91300.

Self-lubricating bronze bearing plates shall be an article of standard production by an established manufacturer of such equipment. They shall be provided with trepanned recesses (not grooves) that shall be filled with a lubricating compound consisting of graphite and metallic substances with a lubricating binder capable of withstanding the atmospheric elements. The lubrication compound shall be compressed into the recesses by pressure to form dense, non-plastic lubricating inserts. The lubricating area shall comprise at least 25 percent of the total area. The static coefficient of friction shall not exceed 0.10.

The certification shall be as specified above and shall include the actual test results showing that bearing plates of the same design as those supplied conform to the static coefficient of friction requirements.

The test specimens shall measure at least 4 in. long by 4 in. wide. The static coefficient of friction shall be determined by testing a specimen plate subjected to a vertical pressure of 1000 psi and 1000 cycles consisting of 1/2 in. horizontal strokes at a speed not to exceed 9 cycles per minute. Testing shall be conducted at an ambient temperature of 77 ± 9 F. The static coefficient of friction on the specimen bearing plate shall be calculated by dividing the total applied vertical load on the plate into the total horizontal load required to start motion between the bearing plate and its mating surface while subject to the vertical load. Upon completion of the test, the bronze plate shall show no signs of galling.

910.01.02 Rolled Copper. Rolled copper alloy bearing and expansion plates shall conform to B 100, Alloy No. 51000.

910.02 STRUCTURAL BEARING PADS. The manufacturer shall furnish certification as specified in Section GP-1.05.

910.02.01 Elastomeric Pads. Elastomeric bearing pads shall conform to the material requirements described in the AASHTO Standard Specifications for Highway Bridges. The elastomeric bearing shall be 60 durometer hardness, Shore Type A. Accompanying the certificate for elastomeric bearing pads shall be two standard ASTM tensile slabs molded from the same compound batch as the furnished elastomeric bearings.

The static load deflection of any layer of elastomeric bearing pads shall not exceed seven percent at 800 psi average unit pressure when tested under laboratory conditions.

The design load for the elastomeric bearing pads will be specified in the Contract Documents. The manufacturer shall proof load each steel reinforced bearing with a compressive load of 1.5 times the maximum design load and shall specify that the material conforms to the material certification.

When test specimens are cut from an actual bearing pad, a reduction of 10 percent in the minimum requirements for original tensile strength and ultimate elongation will be required.

910.02.02 Self-Lubricating Bearing Assembly. Self-lubricating bearing assembly shall consist of a fabric reinforced elastomeric pad, Tetrafluoroethylene (TFE) bonded to the pad, and a stainless steel sheet. All the elements shall conform to AASHTO Standard Specifications for Highway Bridges as modified herein.

Fabric reinforced elastomeric pad shall be Type A, durometer hardness of 70-90. Stainless steel sheet shall be Type 304, minimum thickness of 16 gauge. The surface of the stainless steel sheet in contact with Tetrafluoroethylene shall have 2B finish, and shall be welded to the sole plate using a welding procedure approved by the Engineer.

910.02.03 Pre-formed Fabric Pads for General Application. Pre-formed fabric pads shall be composed of multiple layers of 8 oz cotton duck impregnated and bound with high quality natural rubber or of equally suitable materials, approved by the Engineer and compressed into resilient pads of uniform thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 psi without detrimental reduction in thickness or extrusion.

SECTION 911 – JOINTS

911.01 JOINT SEALER AND CRACK FILLER. Joint sealer and crack filler shall conform to D 6690 as modified by MSMT 404. The manufacturer shall furnish certification as specified in Section GP-1.05. Manufacturer's recommendations regarding heating and pouring temperatures will be used when testing these materials. If a range of temperatures is recommended, the midpoint will be used as the pour point.

911.01.01 SILICONE JOINT SEALER AND CRACK FILLER. Silicone joint sealer and crack filler shall be low modulus, one component compound that may or may not require a primer for bonding to concrete. If a primer is required, it shall be as recommended by the sealant manufacturer and shall be placed on the joint faces following the insertion of the backup material.

Silicone material, when tested at 73 ±3 F and 45-55 percent relative humidity, shall conform to the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Shore A Hardness, at 7 days	D 2240	10-25
Tensile Strength at 150% Elongation, psi max.	D 412 Die C	45
Elongation, % min.	D 412 Die C	700
Adhesion in Peel, Lb/in. min.	Fed. Spec. TT-S-00230	20
Flow, 0.01 in. max.	T 187	0.3
Tack-Free Time, minutes	D 2377	20-75

Each container of silicone sealer and crack filler shall have a minimum shelf life of six months. Material more than six months old shall be retested.

911.02 PREFORMED JOINT FILLERS. Prefomed Sponge Rubber and Cork expansion joint filler shall conform to M 153. Prefomed non-extruding and resilient bituminous type expansion joint filler shall conform to M 213-01 (2010), Section 4.1.2 or 4.1.3.

911.03 PREFORMED JOINT INSERTS. Prefomed inserts shall conform to M 220.

911.04 PREFORMED POLYCHLOROPRENE ELASTOMERIC COMPRESSION JOINT SEALS. The manufacturer shall furnish certification as specified in Section GP-1.05.

911.04.01 Roadway Seals. Roadway seals shall conform to M 220.

911.04.02 Bridge Seals. Bridge seals shall conform to M 297.

The minimum depth of all seals measured at the contact surface shall be at least 90 percent of the minimum uncompressed width of the seal.

911.04.03 Lubricant Adhesive. The lubricant adhesive shall be compatible with the preformed joint seals and concrete. The Engineer will determine that consistency is suitable at the time of installation.

The manufacturer shall furnish certification as specified in Section GP-1.05 showing that lubricant adhesive conforms to the following:

TEST and METHOD	SPECIFICATION LIMITS
Viscosity, D 1084, Method B, CP min.	25,000
Film Strength, D 412, psi min.	2,000
Elongation, D 412, % min.	250

No lubricant adhesive shall be used after nine months from the date of manufacture. Each container shall be plainly marked with the manufacturer's name or trademark, lot number, and date of manufacture.

911.05 NEOPRENE STRIP SEALS. The manufacturer shall furnish certification as specified in Section GP-1.05 showing that the neoprene strip seals conform to the following:

PHYSICAL PROPERTIES FOR PREFORMED ELASTOMERIC STRIP SEALS		
PROPERTY	REQUIREMENT	TEST METHOD
Tensile Strength, psi min.	2000	D 412
Elongation at Break, % min.	250	D 412
Hardness, Type A Durometer, points	60 ± 5	D 2240 (modified) (a) (c)
Oven Aging, 70 hr. at 212 F Tensile Strength, % loss, max. Elongation, % Loss, max. Hardness, Type A Durometer, Points change	20 20 0 to +10	D 573 D 2240 (modified) (a) (c)
Oil Swell, ASTM Oil 3 70 hr. at 212 F weight change, % max.	45	D 471
Ozone Resistance 20% strain, 300 pphm in air, 70 hr. at 104 F	No Cracks	D 1149 (modified) (b)
Low Temperature Stiffening 7 Days at 14 F Hardness, Type A Durometer, Points change	0 to +15	D 2240 D 2240 (modified) (a) (c)
Compression Set, 70 hr. at 212 F, % max.	40	D 395 Method (modified) (b) (a)

- (a) The term "modified" in the table relates to the specimen preparation. The use of the strip seal as the specimen source requires that more applications than specified in either of the modified test procedures be used. The specimen modification shall be agreed upon by the purchaser and producer or supplier prior to testing.
- (b) Test per procedure A of D 518. Ozone concentration is expressed in pphm.
- (c) The hardness test shall be performed with the durometer in a durometer stand as recommended in D 2240.

911.05.01 Special Molded Intersection Pieces. Where joint elements intersect, a special strip seal element manufactured by molding in one piece from neoprene material similar to that specified above shall be 10 in. from point of intersection to nearest end along center line of joint in any direction. Ends shall be plane and square to facilitate bonding to adjacent

extruded areas, and corners of sharp angles shall be rounded sufficiently to relieve damaging stress concentrations. Angles to which moldings are fabricated shall be within 5 degrees of the actual angle as specified in the Contract Documents to avoid excessive deformation when installed in steel joint components.

Lubricant adhesive for use in installing and bonding neoprene seal elements to steel joint components shall be one part moisture curing polyurethane and hydrocarbon solvent mixture having the following physical properties:

TEST AND METHOD	SPECIFICATION LIMITS
Average Weight, lb/gal.	8 ± 0.8
Solids Content, % min.	65
Adhesives shall remain liquid from, F	5 to 120
Film Strength, D 412, psi min.	2000
Elongation, D 412, % min.	250

Steel extrusions and neoprene seals shall be matching components by the same manufacturer. The steel extrusions shall have a thickness of at least 3/8 in. All steel portions of the joint assembly shall be painted with an inorganic zinc rich primer meeting the requirements of Section 912.02 and applied as specified in Section 413.

911.06 SEALER FOR LOOP DETECTOR. Sealing material to seal saw cuts for loop detector wires shall be either Type A, two part epoxy or Type B, one part polyurethane. The manufacturer shall furnish certification as specified in Section GP-1.05.

No aggregate shall be mixed with the sealer material. The sealer shall be applied in conformance with the manufacturer's recommendations.

911.06.01 Tests. Tests shall conform to the following:

TYPE A – TWO PART EPOXY	
TEST AND METHOD	SPECIFICATION LIMITS
Viscosity, cone and plate Viscometer @ 25 C, cps max.	12,000
Pot life @ 25 C, minutes min.	10
Cure Time @ 25 C, no tackiness, hr. max.	1
Hardness, Type A Durometer, D 2240	50 – 60
Tensile Elongation, D 638, % min.	100
Water absorption, D 570, %/24 hr. max.	0.5
Oil absorption, D 471, % max.	0.02
Volume resistivity @ 25 C, D 257, Ohm-cm min.	2.4 x 10 ¹⁰

TYPE B – ONE PART POLYURETHANE	
TEST AND METHOD	SPECIFICATION LIMITS
Viscosity, Brookfield RVF #6 spindle @ 20 rpm 25 C, cps max.	30,000
Cure time @ 25 C, no tackiness, hr. max.	24
Hardness, Rex Type A	50 – 60
Tensile Strength, D 412, psi min.	500
Tensile Elongation, D 412, % min.	300
ARC Resistance, D 495, sec. min.	70
Dielectric Constant, D 150, min.	6 @ 50 hz., 4.25 @ 500 hz.
Nonvolatile Content, %	85

911.07 ROOFING PAPER. Roofing paper to be used in expansion joints shall be composed of roofing felt saturated and coated on both sides with an asphaltic material. It shall not weigh less than 39.8 lb/100 sq.ft. and shall not crack when bent 90 degrees over a 1/2 in. radius at room temperature.

911.08 WATERSTOPS. Waterstops shall be made of rubber or polyvinyl chloride (PVC).

The waterstop shall be of the shape and dimensions specified in the Contract Documents. The cross section shall be uniform along its length and transversely symmetrical so that the thickness at any given distance from either edge of the waterstop shall be uniform.

The waterstop shall conform to the following:

TEST AND METHOD	SPECIFICATION LIMITS
Tensile Strength, D 412, psi min.	2000
Elongation @ Break, D 412, % min.	300
Hardness, Rubber, Type A durometer, D 2240	55 ± 5
Hardness, PVC, Type A durometer, D 2240	75 ± 5

The Contractor shall furnish a test sample for each lot or shipment of waterstop. The manufacturer shall furnish certification as specified in Section GP-1.05.

911.09 ASPHALT SEALER FOR CONCRETE PIPE. The sealer shall be a mixture of asphalt, mineral filler, and petroleum solvents, and shall have adhesive and cohesive properties. Each container shall be clearly marked with a lot number, manufacturer and location of manufacturer.

The supplier shall furnish a certified copy of the test results showing that the sealer meets the following:

TEST AND METHOD	SPECIFICATION LIMITS
Residues by evaporation, nonvolatile Matter, D 2939, % min.	70
Inorganic filler on ignition, ash content, D 2939, %	15 – 45

911.10 CLOSED CELL NEOPRENE SPONGE ELASTOMER. Closed cell neoprene sponge elastomer shall conform to D 1056, Type 2. Skin coating is optional. The material shall conform to the following:

TEST AND METHOD	SPECIFICATION LIMITS
Compression Deflection, D 1056	Pressure necessary for 25% deflection, 5-10 psi, one layer ½” thick Pad @ 70 ± 5 F
Accelerated Aging Test	Change in compression deflection after aging 7 days @ 158 F, 20% max.
Permanent set*, D 1056	50% deflection @ 158 F for 22 hrs., 40% max. residual permanent set after 10 days recovery, 10% max.
Water absorption by weight	2 in. immersion of 1.129 in. diameter sample for 24 hr. @ room temperature, 10% max.
Water Resistance, D 1171	Quality retention, 6 weeks exposure, 100%

* Method to calculate permanent set:

$$Permanent _ Set = \frac{(t_0 - t_1) \times 100}{t_0}$$

where:

t₀ = original thickness of sample, and

t₁ = thickness of specimen 30 minutes after removal of clamps or after 10 days recovery.

911.11 DRAINAGE TROUGHS.

911.11.01 Neoprene Drainage Troughs. Neoprene for drainage troughs shall conform to M 220, and the following:

NEOPRENE DRAINAGE TROUGHS		
PHYSICAL PROPERTY	METHOD	LIMITS
Thickness, in., min.	-	¼
Tensile Strength, psi, min.	D 412	2000
Elongation at Break, % min.	D 412	250
Hardness, Type A Durometer	D 2240 (modified)	60 ± 5
Compression set, 22 hr. @ 212 F, % max.	D 395	35
Oven Aging, 70 hr. @ 212 F	D 573	
Tensile Strength, % loss max.		20
Elongation, % loss max.		20
Hardness, Type A Durometer, (Points change)		0 to +10

911.11.02 Optional Preformed Fabric Drainage Troughs. A sheet composed of multiple plies of 15 ± 5 oz/sq.yd. polyester fabric laminated with butadiene acrylonitrile, vulcanized to form an integral laminate. Physical properties of the laminate shall meet the following:

ALTERNATE PREFORMED FABRIC DRAINAGE TROUGHS		
PHYSICAL PROPERTY	METHOD	LIMITS
No. of Plies	-	3
Laminate Weight, lb/sq.ft. min.	-	0.85
Thickness, in. min.	-	5/32
Breaking Strength, lb/in. min.	D 378	1200
Elongation at Break, % max.	D 378	30
Elongation at 1/10 Breaking Strength, % max.	D 378	3

911.12 Preformed Flexible Joint Sealants. Preformed flexible joint sealants for use with precast concrete structures and pipe shall be the butyl rubber type conforming to C 990, Section 6.2. Sealant as specified shall not be used in expansion joints or joints that move.

SECTION 912 – COATING SYSTEMS FOR STRUCTURAL STEEL

912.01 GENERAL. The Design Division shall approve paint selections and suppliers. Unless otherwise specified, paint shall be tested in accordance with Federal Test Method Standard 141. Only one formulation per color will be permitted per project. Tests shall be performed at 75 F and 50 percent relative humidity unless otherwise specified. All paint shall be satisfactory for brushing, rolling, or spraying. All paints within a system shall be from the same manufacturer and shall be tinted at the point of manufacture to differentiate between coats, existing coats, and bare metal. Paint shall be shipped in the original containers and all containers shall bear the identification of the paint, consisting of the manufacturer’s name, the name or title of material, volume of contents, manufacturer’s paint identification number, the date of manufacture, color name and number, handling instructions, Materials Safety Data Sheet, precautions, and the batch number.

912.01.01 Approved Paint Manufacturers. Approval of Paint Manufacturers shall be based upon the acceptance of the manufacturer’s submitted Quality Control Plan.

912.01.02 Quality Control Plan. The Quality Control Plan shall define the manufacturer’s process to ensure the quality of the products during and upon completion of the manufacturing process. As a minimum, the Quality Control Plan shall list the following information:

- (a) Name of quality control tests and test procedures used.
- (b) Detailed description of the test procedures if not a standard test.

(c) Frequency of quality control tests.

(d) Maintenance of quality control records and length of time that they will be maintained.

912.01.03 Acceptance. The paint manufacturer shall furnish certified test results for each lot and color of paint as specified in Section GP-1.05. Certified test results for each lot shall list the actual test results for the specified properties. The Structural Design Section shall approve the certification prior to shipment, and a copy shall accompany each shipment.

912.01.04 Original Infrared Spectrogram. The manufacturer shall submit an original analysis of vehicle solids by infrared spectroscopy performed as specified in D 2621 as follows:

(a) For zinc primer coatings, infrared spectrum of each vehicle component.

(b) For two component coatings, infrared spectrum of each single component and each mixed component, when applicable, in appropriate mixing ratios.

912.01.05 Certification Verification Tolerances. The manufacturer's facilities will be visited at random intervals, and samples will be taken. A comparison will be made between the manufacturer's certified test results and the County's tests results on the same batch. The tolerances between these results shall meet the following:

TEST	TOLERANCE	TEST METHOD
Total Solids by mass, %	± 2	D 2369
Pigment Content by mass, %	± 2	D 2698 or D 4451
Vehicle Solids by mass, %	± 2	D 2369
Viscosity, KU	± 10	D 562
Unit Weight, lb/gal	± 0.5	D 1475

**Volatile Organic Compound (VOC) maximum limits shall meet the current regulations governing the point of application.*

912.02 PRIMER COATS AND SEALERS.

912.02.01 Inorganic Zinc Rich. Per M 300, Type I or IA. Zinc dust per D 520, Type II.

912.02.02 Aluminum Epoxy Mastic. Aluminum epoxy mastic primer shall have one component that is the condensation product of the reaction of epichlorohydrin with bisphenol A. Drying times shall be 8 hours maximum to touch, 24 hours minimum to 30 days maximum for recoat, and 48 hours maximum for hard. Minimum pot life shall be three hours. Solids by weight shall be 90 percent minimum and 80 to 90 percent by volume. Viscosity shall be 95 to 140 KU and flexibility shall pass a 180-degree bend around a 3/4 in. mandrel

when tested per D 522. The material shall resist sagging when tested per D 4400 with no sagging at the manufacturer's recommended wet film thickness. The material shall weigh 13.0 ± 0.5 lb/gal.

912.02.03 Organic Zinc Rich. Per SSPC-Paint 20, Type II.

912.02.04 Zinc Rich Moisture Cured Urethane. One-component having a minimum zinc pigment content in the dry film of 80 percent. Minimum solids shall be of 80 percent by weight and 62 percent by volume. The viscosity shall be 95 to 105 KU, and shall be capable of being applied at 50 percent greater film build than required without runs or sags per D 4400. The interval for application of the next coat shall be 8 hours minimum and 30 days maximum. The coating shall also meet the Moisture Cured Urethanes Additional Performance Criteria Table except that the maximum loss for Abrasion Resistance shall be 82.0 mg, and Salt Spray after 1000 hours shall be 1/32 in. maximum.

912.02.05 Micaceous Iron Oxide and Aluminum Filled Moisture Cured Urethane shall have a minimum solids content of 75 percent by weight and 60 percent by volume.

The viscosity shall be 95 to 100 KU. The coating shall also meet the Moisture Cured Urethanes Additional Performance Criteria Table.

912.02.06 Penetrating Sealer. A viscosity of 75 to 101 KU and be able to penetrate and seal existing coatings and substrate. It shall be suitable for application over marginally prepared steel and most generic types of aged coatings. The sealer shall conform to one of the following:

- (a) Epoxy penetrating sealer shall be cross-linked amido-amine epoxy primer/sealer having two components mixed in accordance with the manufacturer's recommendations. It shall be a minimum of 95 percent solids by weight.
- (b) Moisture cured urethane micaceous iron oxide filled penetrating primer/sealer shall be one component having a minimum of 75 percent solids by weight. It shall also meet the Moisture Cured Urethanes Additional Performance Criteria Table.

912.03 INTERMEDIATE COATS.

912.03.01 Acrylic. Coating shall consist of a single component 100 percent acrylic and have minimum solids of 48 percent by weight and 36 percent by volume. The maximum dry time to touch and recoat shall be 2 and 8 hours, respectively.

912.03.02 Epoxy Polyamide. Epoxy polyamide intermediate coat shall have one component that is the condensation product of the reaction of epichlorohydrin with bisphenol A. The epoxy polyamide shall have a 3.0 minimum fineness of grind (Hegman Units), and minimum solids of 75 percent by weight and 62 percent by volume. Maximum dry time to touch and recoat shall be 6 and 15 hours, respectively.

912.03.03 Micaceous Iron Oxide Moisture Cured Urethane. Micaceous Iron Oxide Moisture Cured Urethane shall be one-component having minimum solids of 80 percent by weight and 60 percent by volume. The viscosity shall be 90 to 100 KU. The interval for application of the next coat shall be 8 hours minimum and 30 days maximum. The coating shall meet the Moisture Cured Urethanes Additional Performance Criteria Table. The micaceous iron oxide content shall be at least 3.0 lb/gal.

912.04 FINISH COATS. The color number will be specified in the Contract Documents and shall conform to Federal Standard 595. All finish coats shall resist sagging when tested per D 4400 with no sagging at the manufacturer's recommended wet film thickness.

912.04.01 Acrylic. Refer to Section 912.03.01.

912.04.02 Aliphatic Urethane. Finish coat shall have minimum solids of 70 percent by weight and 47 percent by volume. Drying time to touch and hard shall be the minimum recommended by the paint manufacturer.

912.04.03 Moisture Cured Aliphatic Urethane. Finish coat shall be one-component having a maximum free monomer content of 0.7 percent. Minimum solids shall be 75 percent by weight and 60 percent by volume, and the viscosity shall be 70 to 80 KU. The interval for application of the next coat shall be 8 hours minimum and 30 days maximum. The coating shall meet the Moisture Cured Urethanes Additional Performance Criteria Table.

912.05 PAINT SYSTEMS. As specified in the Paint Systems Table.

PAINT SYSTEMS TABLE

PAINT	COAT	SECTION	DRY FILM THICKNESS, mils, min - max	USAGE
SYSTEM A				
Inorganic Zinc	I	912.02.01	3.0 - 5.0	Shop Primer
Acrylic	II	912.03.01	2.0 - 4.0	First Field Coat
Acrylic	III	912.04.01	2.0 - 4.0	Finish Coat
SYSTEM B				
Inorganic Zinc	I	912.02.01	3.0 - 5.0	Shop Primer
Epoxy Polyamide	II	912.03.02	5.0 - 8.0	First Field Cover-All Coat
Aliphatic Urethane	III	912.04.02	2.0 - 3.0	Finish Coat
SYSTEM C				
Organic Zinc	I	912.02.03	3.0 - 5.0	Primer/First Cover-All Coat
Epoxy Polyamide	II	912.03.02	5.0 - 8.0	Second Cover-All Coat
Aliphatic Urethane	III	912.04.02	2.0 - 3.0	Finish Coat

PAINT	COAT	SECTION	DRY FILM THICKNESS, mils, min - max	USAGE
SYSTEM D				
Organic Zinc	I	912.02.03	3.0 - 5.0	Primer/First Cover-All Coat
Acrylic	II	912.03.01	2.0 - 4.0	Second Cover-All Coat
Acrylic	III	912.04.01	2.0 - 4.0	Finish Coat
SYSTEM E				
Aluminum Epoxy Mastic	I	912.02.02	5.0 - 8.0	Primer/First Cover-All Coat
Epoxy Polyamide	II	912.03.02	5.0 - 8.0	Second Cover-All Coat
Aliphatic Urethane	III	912.04.02	2.0 - 3.0	Finish Coat
SYSTEM F				
Micaceous Iron Oxide, Aluminum Filled Moisture Cured Urethane	I	912.02.05	2.0 - 3.0	Primer/First Cover-All Coat
Micaceous Iron Oxide Moisture Cured Urethane	II	912.03.03	3.0 - 5.0	Second Cover-All Coat
Moisture Cured Aliphatic Urethane	III	912.04.03	1.5 - 2.0	Finish Coat
SYSTEM G				
Zinc Rich Moisture Cured Urethane	I	912.02.04	2.0 - 3.0	Primer/First Cover-All Coat
Micaceous Iron Oxide Moisture Cured Urethane	II	912.03.03	3.0 - 5.0	Second Cover-All Coat
Moisture Cured Aliphatic Urethane	III	912.04.03	1.5 - 2.0	Finish Coat
SYSTEM H				
Penetrating Sealer	I	912.02.06	1.0 - 2.0	Sealer
Aluminum Filled Epoxy Mastic	II	912.02.02	3.0 - 5.0	Spot Coat
Aliphatic Urethane	III	912.04.02	3.0 - 5.0	Finish Coat

**MOISTURE CURED URETHANES
ADDITIONAL PERFORMANCE CRITERIA TABLE**

TEST PROPERTY	TEST METHOD	TEST CRITERIA	COAT I and II	ENTIRE SYSTEM
Cyclic Salt Fog/UV Exposure of Painted Metal	D 5894	Final Ratings: Rusting: 6 min Blistering: 10 min Rust Creep: 6 max Cracking: Degree & Type Flaking: Degree & Type	1000 hr	3000 hr
Salt Spray	B 117	1/32 in Scribe, 1/16 in. max undercut	1000 hr	3000 hr
Abrasion Resistance	D 4060	Taber Abraser, CS-17 Wheel, 1000 g load, 1000 cycles, max loss	100 mg	56 mg
Adhesion	D 3359	Cross-Cut Tape Test	No peeling or removal	No peeling or removal
Flexibility	D 522	Conical Mandrel Bend Test, min elongation	10 %	40 %
Pencil Hardness	D 3363	min	F	F
Accelerated Weathering	G 53	QUV using UV - B Lamp, time after no more than 10 % loss of gloss	—	400 hr
Impact Resistance	D 2794	min	—	40 in.·lb
Chemical Resistance, Solutions	Fed. Spec. T-C-550 4.4.6	5 % Sodium Hydroxide 5 % Hydrochloric Acid 5 % Sulfuric Acid 5 % Acetic Acid	—	Unaffected - Slight discoloration permitted
Reversed Impact	D 2794	Rapid Deformation	—	No cracking or delamination

SECTION 913 – WATERPROOFING

913.00 CERTIFICATION. The producer shall furnish certification as specified in Section GP-1.05.

913.01 ASPHALTIC MATERIALS FOR DAMP-PROOFING AND WATER-PROOFING.

913.01.01 Hot Applied Asphalt. Per D 449.

913.01.02 Cold Applied Asphalt. Meet the following when tested per MSMT 423, Procedure A. The material shall not contain isocyanide or any derivative of cyanide.

TEST and METHOD		SPECIFICATION LIMITS		
		GRADE I	GRADE II	GRADE III
R and B Softening Point T 53		104 – 143 F	145 – 170 F	172 – 200 F
Penetration, 0.10 mm, T 49	32 F, 200 g, 60 sec	10 min	5 min	5 min
	77 F, 100 g, 5 sec	30 – 100	25 – 50	20 – 40
	115 F, 50 g, 5 sec	100 min	130 max	100 max
Permeability, g/cubic cm, max, MSMT 423		0.09	0.09	0.09
Flow test, mm, max, MSMT 423		CC	20	15
Flexibility, 60 F, MSMT 423		No peeling or loss of adhesion		
Imperviousness Test, MSMT 423		No pitting or discoloration		
Sag test, MSMT 423		No movement		

Grade I— Suitable for below ground and horizontal applications.

Grade II—Suitable for below ground and above ground where surface temperatures do not exceed 120 F.

Grade III—Suitable for below ground and above ground where surface temperatures exceed 120 F.

913.01.03 Cold Applied Asphalt Emulsion. Per D 1227, Type II, using D 2939, modified by MSMT 423, Procedure B.

913.02 PRIMER FOR USE WITH ASPHALT FOR DAMPPROOFING AND WATERPROOFING. Per D 41.

913.03 FABRIC SATURATED WITH ASPHALT FOR USE IN WATERPROOFING. Per D 173.

913.04 DAMPPROOFING AND WATERPROOFING MEMBRANE. The adhesive side of the membrane shall be protected with a special release paper that can be easily removed for installation. The membrane shall meet the following requirements:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Grab Tensile Strength, lb/in. @ 12 in./minute rate of loading, min	D 5034	70
Pliability, 180° bend, 1 in. mandrel @ 20 F	D 146	unaffected
Resistance to Puncture, lb min	E 154 (square mounting frame method)	40
Permeance, perm (kg/Pa · s · m ²), max	E 96, Procedure B	0.1

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Weight, oz/sq.yd. min	D 3776	40
Primer	—	as specified by the manufacturer

Roll and sheet waterproofing membrane may be accepted on certification. The manufacturer shall furnish certification as specified in Section GP-1.05 with actual test results showing that the material meets these Specifications.

913.05 SHEET METAL FOR FLASHING. Shall be of the material and gauge specified.

913.05.01 Copper. Per B 152 for weight per square foot and gauge.

913.05.02 Galvanized Sheets. Per A 653, Coating Designation G 90.

SECTION 914 – CHAIN LINK FENCE

914.00 CERTIFICATION. The manufacturer shall furnish certification as specified in Section GP-1.05. In addition, a sample of the fence fabric shall be submitted with the fabric certification.

914.01 CHAIN LINK FENCING FABRIC. Chain link fencing fabric shall be 2 in. mesh woven from coated No. 6 gauge wire for 6 ft and 8 ft fence and No. 9 gauge wire for 5 ft fence unless otherwise specified in the Contract Documents. The ends shall have a knuckled selvage at the bottom and a barbed selvage at the top. The fabric shall conform to M 181. Type I fabric shall conform to Class D coating. Vinyl coated steel shall conform to F 668, Class 2B thermally fused. Vinyl color shall be warm gray or black as specified in the Contract Documents. Where used for stormwater management facilities, the chain link fence characteristics shall be as directed by the Department of Environmental Protection and Sustainability, to be summarized in the Contract Documents.

914.01.01 Fence Fabric for Super Silt Fence. Galvanized fabric for super silt fence shall meet Section 914.01 except that it shall be woven from No. 6 gauge wire having a Class C coating. The fabric shall be 42 in. high.

914.02 TIE WIRES, LINE POST CLIPS, TENSION WIRES AND TENSION WIRE CLIPS. These items shall conform to M 181. The galvanized coating shall weigh a minimum of 1.2 oz/sq.ft.. These items, when used with aluminum coated steel fabric, shall be coated with aluminum at a minimum weight of 0.40 oz/sq.ft.. The tension wire used with polyvinyl chloride (PVC) coated steel fabric shall have the same coating thickness and color requirement as the fence fabric.

914.03 POSTS, BRACES, FITTINGS AND HARDWARE. All posts, braces, fittings and hardware shall conform to M 181. When these items are specified to be PVC coated, they shall be thermally fused and bonded. The PVC thickness shall be 10 to 15 mil except that bolts, nuts, and washers shall be metallic coated steel.

When opting to use round posts, the posts shall conform to industry standards for Grade 1 or Grade 2.

914.04 GATES. The fabric used for gates shall be identical to the fencing fabric. The gate frame and other hardware shall conform to Sections 914.02 and 914.03. When the gate frame is PVC coated, movable fittings, such as hinges and latches, shall be field coated with a PVC coating specifically prepared for this purpose.

914.05 BARBED WIRE. Barbed wire shall conform to A 121. The barbed wire shall be 12½ gauge with four point, round barbs at 5 in. spacings and Coating Type Z, Class 3 coating requirements.

SECTION 915 – PRODUCTION PLANTS

915.01 GENERAL. These specifications are applicable to all batching and proportioning plants.

915.01.01 Approval. The plant from which the Contractor proposes to obtain material to be used on Baltimore County projects must have approval by the Maryland State Highway Administration (MdSHA).

915.01.02 Lead Time. Notify the Engineer at least two working days prior to the start of operations. The Division of Construction Contracts Administration shall be kept informed of plant operational procedures and be notified when a change is planned. Inspectors shall have safe access to all areas of the plant for the performance of their duties. All equipment, tools, machinery, and parts of the plant shall be maintained in a satisfactory working condition at all times.

915.01.03 Storage. The storage and handling of aggregates in stockpiles and bins shall be done in a manner that will prevent segregation, intermingling, and contamination by foreign material or equipment. Bins discharging to feeder systems shall be equipped with accessible calibrated devices to vary the quantity of material being fed.

915.01.04 Measuring Devices. Measuring devices shall meet the current edition of the National Institute of Standards and Technology Handbook 44, except as modified by Table 915. The producer shall provide all personnel and equipment for calibrating measuring devices.

Before the plant starts any proportioning operation, and at least once each year thereafter, all measuring devices, meters, dispensers, test weights, and other measuring devices shall be

inspected, tested, and certified to be in proper operating condition by an approved testing agency. During the period of operation, all measuring devices, including meters and dispensers, shall be tested and certified for accuracy and operating condition by the producer or an approved testing agency on a monthly basis during the period of operation. Any weighing device by which materials are sold by weight as a basis of payment shall be tested monthly and certified by an approved testing agency. The Engineer shall be notified at least two working days in advance of monthly scale inspections. The certifications shall state capacities, minimum graduations, loads applied, degree of accuracy, and magnitude.

Balance and zero conditions of scales shall be checked daily, and at any other time requested by the Division of Construction Contracts Administration. The Engineer may, at any time, direct that any measuring device be tested by the producer or by an outside agency if there is any doubt about the accuracy of the measuring device. Certificates of inspection shall be posted in a prominent place in the plant, and a copy shall be promptly submitted to the Engineer.

Production plant tolerances shall meet the following table:

TABLE 915

MATERIAL	*MAINTENANCE TOLERANCE	UNIT OF MEASUREMENT
Aggregate	0.2%	Weight
Portland Cement or Blended Hydraulic Cement of Ground Iron Blast Furnace Slag or Fly Ash	0.2%	Weight
Asphalt	0.2%	Weight or Volume
Water	1.5%	Weight or Volume
Additives	0.5%	Weight or Volume

*Maintenance tolerance shall be the larger of specified percent of the total capacity of the scale or the smallest scale graduation.

If, during the monthly check, the measuring devices are found to deviate from the allowable tolerance, they will be suspended from use until recalibrated to the Specification requirements. A price adjustment will apply to materials sold and accepted by weight that are supplied during the measuring device malfunction period when the malfunction resulted in an overpayment. The measuring device malfunction period is defined as the elapsed time between the two successive monthly checks.

915.01.05 Sampling Equipment. The producer shall provide all personnel and equipment for obtaining samples from the last practical point prior to combination with other ingredients or introduction into the mixer. Sampling of liquid binder from HMA plants shall be from a tap located at the last practical, safe point, between the binder control unit and the plant (M 156 and D 140). Sampling shall meet Tables 1 and 2 of the MSMT Manual. The sampling equipment shall have a minimum capacity of 30 lb and be positioned in a manner that will provide an accurate representation of the material being furnished. When the size of the sample is too large to be transported, approved sample splitting devices shall be available at the point of sampling that will split the sample to no more than twice the proper testing size.

915.01.06 Quality Control Laboratory. At proportioning or batching plants the producer shall provide an on-site County-approved laboratory suitable for conducting the various tests required. An off site laboratory requires approval of the Engineer. Continued approval of the laboratory and the testing personnel will be subject to periodic inspection by the County. Any deficiencies shall be corrected to the satisfaction of the Engineer or the approval will be withdrawn.

915.02 HOT MIX ASPHALT (HMA) PLANTS. All plants providing HMA material to Baltimore County projects must have approval from the Maryland State Highway Administration (MdSHA), meet M 156, and be equipped with Automatic Batching and Recording of Batching, except as modified in Section 915.01 and the following:

- (a) **Dryer.** The fuel used for drying aggregates shall be compatible with the plant manufacturer's recommendations.
- (b) **Hot Aggregate Bins.** New plants shall meet the requirements of M 156.
- (c) **Mixer Unit for Batch Method.** Minimum dry and wet mixing times shall be 5 seconds and 15 seconds, respectively.
- (d) Truck scale weighing shall meet the National Institute for Standards and Technology (NIST), except as follows:
 - (1) A plant summary shall be kept by the producer showing the Contract number, truck identification (ID) number, ID of the type of mix being produced, the number of truck loads, and the total tons of mix.
 - (2) The producer shall supply a delivery ticket with the ID number, Contract number, State-approved mix number, date, truck ID number, time loaded, gross and tare weights, and net weight of the mix for each load. When requested by the Engineer, the temperature of the mix shall be shown on the delivery ticket.
- (e) **Automatic Weighing and Printout.** The producer shall use an approved plant automatic weighing and printing system. A printed delivery ticket for each load shall be provided with the cumulative total weighed into the truck, Contract number, time loaded, State-approved mix number, and net weight of mix. When requested by the Engineer, the temperature of the mix shall be shown on the delivery ticket. The temperature may be handwritten.
- (f) **Hauling Units.** Transport the mixture to the work site in units previously cleaned of all foreign material, and with the contents of each load completely covered with suitable material of sufficient size to protect it from the weather. Each unit shall have convenient access from ground level to insert thermometers to determine mix temperature.

Treat the inside surface of all hauling units with an approved release agent that will not contaminate or alter the characteristics of the mixture. Petroleum derivatives are prohibited. Approval will be based on results from tests performed per MSMT 414.

- (g) Drum mixer plants shall be calibrated per MSMT 453 and approved. A monitoring station for the purpose of controlling the entire operation shall be provided. If any part of this control system fails, an alternative control system approved by the Engineer may be used for a maximum of two working days.

The producer shall determine the moisture content of all aggregates per MSMT 251.

915.02.01 Certified Hot Mix Asphalt (HMA) Plant. The producer is responsible for quality control of plant operations to ensure that the material meets Specifications. The quality control process will be subject to unannounced periodic inspection by representatives of the Engineer when County projects are in progress. The plant's certified technician shall fully participate in the inspections.

Initial Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether the plant equipment and personnel meet all applicable Specifications. The County will accept certification by a Professional Engineer registered in the State of Maryland that the plant facilities meet all applicable Specifications; however, the County shall determine final acceptance.

Responsibilities of the HMA Producer.

- (a) **Notification.** Notify the Engineer one working day prior to producing materials for County projects. Report total tons shipped to County projects within one business day of completed daily shipments.
- (b) **Quality Control.** The minimum sampling and testing frequencies and criteria necessary for quality control of the HMA is the responsibility of the producer. Develop and use a quality control plan acceptable to the Engineer that addresses all elements necessary for quality control in the plant.

Conduct the minimum sampling and testing as specified in MSMT 735, Table 2. Additional sampling and testing shall be performed when directed. The Engineer shall be offered the opportunity to witness all sampling and testing.

- (c) **Reports.** The test results shall be furnished to the Engineer on documents approved by the County.

915.03 PORTLAND CEMENT CONCRETE PLANTS. Per M 157, except as modified herein, including the applicable requirements of Section 915.01.

915.03.01 Storage of Aggregate. Coarse and fine aggregate for use in Portland cement concrete shall be maintained at a uniform moisture content in excess of its saturated surface dry condition. Water added for this purpose shall meet the requirements given in Section 921.01.

915.03.02 Temperature of Water and Cement. The plant shall be equipped with approved methods of heating and cooling the mix. The temperature of the plastic concrete shall meet the requirements given in Section 902.10.03. The temperature of the cementitious materials and the mixing water at the time they are used in the mix shall not exceed 170 F.

915.03.03 Load Tickets. A MdSHA-approved computer generated batch ticket indicating the pertinent information per M 157 shall be provided in duplicate for each load. The ticket shall indicate maximum allowable water, and maximum water allowed for jobsite slump adjustment. Distribution shall be made as specified in Section 915.03.05(c)(2). The producer's copy shall be readily available for inspection upon request by the Engineer. A completed MdSHA Form 116 shall be issued for each load in the event a computer generated batch ticket cannot be provided.

915.03.04 Mixers and Agitators. The requirements for mixers and agitators and for mixing and delivery of ready mixed concrete shall conform to M 157 with the following exceptions:

- (a) During transit, operate drums at agitating speed only. Mixing during transit is prohibited.
 - (1) At least 85 percent of design water requirement shall be added at the plant through the certified plant water meter.
 - (2) Water for slump adjustment may be added at the plant through the MdSHA-approved truck water system under the supervision of the certified concrete technician, provided the maximum specified water/cement ratio is not exceeded.
 - (3) A maximum of 3 gal of water per cubic yard of concrete may be added at the job site provided the maximum specified water/cement ratio is not exceeded.
 - (4) Adding water after partial discharge of the load is prohibited.
- (b) Loading of mixers or agitators that contain wash water in the drum is prohibited.
- (c) When the concrete is specified or permitted to be made by volumetric batching and continuous mixing, the batching and mixing unit shall meet C 685. Calibration shall meet MSMT 558.

Where no mixer performance tests are made for stationary mixers, the minimum mixing time is 75 seconds.

915.03.05 Certified Concrete Plant. Concrete plants providing material to Baltimore County projects shall be certified by the Maryland State Highway Administration (MdSHA) and shall satisfy all criteria outlined in the Maryland Department of Transportation State Highway Administration *Standard Specifications for Construction and Materials*, latest edition. The producer shall be responsible for quality control of plant operations to ensure that the material meets Specification requirements. The quality control process will be subject to unannounced periodic inspection by the Division of Construction Contracts Administration. Full participation in the inspection by the plant's certified technician will be required.

Initial Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether the plant equipment and personnel meet all applicable Specification requirements. The MdSHA will accept certification, signed and sealed by a Professional Engineer registered in the State of Maryland, that the plant facilities meet all applicable Specification requirements.

Responsibilities of the Concrete Producer.

- (a) **Notification.** Notify the Engineer one working day prior to producing materials for County projects. Proceed with production only with the Engineer's approval.
- (b) **Quality Control.** Have the certified concrete plant technician present while concrete is being batched and delivered to the project. This technician shall supervise concrete production.
 - (1) Develop and use an acceptable Quality Control Plan that addresses all elements necessary for quality control in the plants.
 - (2) The certified concrete plant technician shall perform control tests. This technician shall perform moisture tests, adjust proportions of aggregate for free moisture, complete and sign batch or approved delivery tickets, and ensure quality control of the batching operations.
 - (3) Technician certification will be awarded upon satisfactory completion of examinations per MSMT 560.
 - (4) Supply all necessary test equipment.
 - (5) Sample frequency shall meet the MSMT Frequency Guide, Table 1.
- (c) **Reports.** The producer shall process the following reports:
 - (1) MdSHA Form 113, daily, stating that the material was sampled and tested in accordance with sampling and testing guidelines and complies with the applicable Specifications. Make a distribution to the producer's file and the Division of Construction Contracts Administration.

- (2) MdSHA Form 116, for each load. Make a distribution to the Division of Construction Contracts Administration's project file and producer's file.
- (3) Forms for all concrete materials sampled at the plant per MSMT Frequency Guide, Table 1.
- (4) Test Worksheet, daily, for all tests performed at the plant.

915.03.06 Moisture Probes. Moisture probe readings may be used in place of actual daily moisture testing of fine aggregate. When used, moisture probes shall be calibrated and maintained per the manufacturer's recommendations. Actual moisture tests for the fine aggregate shall be performed weekly and as directed. When the actual tests of the fine aggregate indicate a difference of greater than 0.5 percent free moisture than that of the moisture probe readings, a second actual test shall be performed immediately. When the second test indicates a moisture difference of greater than 0.5 percent, then the moisture probe shall be recalibrated per the manufacturer's recommendations and verified. Records of all calibrations and weekly tests shall be maintained and made available to the Engineer.

915.04 BASE COURSE PLANTS.

915.04.01 Non-stabilized. Base course plants producing graded aggregate base material without a stabilizing agent shall meet the requirements of Sections 915.01, 915.04.03, and the following:

- (a) The material is produced in a processing plant using an approved aggregate source.
- (b) The Quality Control Plan shall be submitted to and approved by the MdSHA prior to production.
- (c) The production shall meet the gradation requirements of the approved job mix formula.
- (d) The required moisture content shall be maintained prior to shipment.
- (e) Stockpiles shall be maintained to prevent segregation.
- (f) Frozen aggregates shall not be used.
- (g) Mixed material shall be handled and transported in a manner that will minimize segregation and the loss of moisture. All loads shall be covered in accordance with State laws unless hauling is off road and approved by the Engineer.

915.04.02 Stabilized. Stabilized base course plants shall meet the requirements of Sections 915.01, 915.04.03, and the following:

- (a) Mechanical mixers shall be used, as approved. All plants shall be equipped with automatic cutoff devices interlocked so the plant will stop operating if delivery of any component of the mix fails.
- (b) The amount of stabilization shall be determined per MSMT 254.
- (c) The charge in a batch mixer or rate of feed to a continuous mixer shall not exceed that which will permit complete mixing of all materials.
- (d) Mixed materials shall be handled and transported in a manner that will minimize segregation and loss of moisture or volatiles. All loads shall be covered in accordance with State laws unless hauling is off road and approved by the Engineer.
- (e) When cement is used as a stabilizing agent, the amount of water added at the plant shall be controlled to obtain a uniform mixture that meets the required density.
- (f) When emulsified asphalt is used as a stabilizing agent, all aggregate shall contain moisture in excess of the saturated surface dry condition at time of mixing.

915.04.03 Certification of Base Course Plants. The quality control and condition of all materials used in base courses, as well as all necessary adjustments required in using the materials, is the responsibility of the base course producer. The quality assurance process will be subject to unannounced periodic inspection by representatives of the Division of Construction Contracts Administration when County projects are in progress. The plant's certified technician shall participate in the inspection.

Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether the plant equipment and personnel meet all applicable Specification requirements. After the initial inspection the plant shall meet the requirements given in Section 915.01.04. The County will accept certification (signed and sealed by a Professional Engineer registered in the State of Maryland) that the plant facilities meet all applicable Specification requirements. However, the Engineer shall determine final acceptance.

Responsibilities of the Base Course Producer.

- (a) **Notification.** Notify the Division of Construction Contracts Administration one working day prior to producing materials for County projects.
- (b) **Quality Control.** The producer is responsible for quality control of plant operations to ensure that the material meets Specification requirements. All producers supplying base courses shall have a certified base course plant technician present while base course material is being plant mixed and delivered to the project. This technician shall supervise base course production.

- (1) A certified base course plant technician shall perform Control tests. This technician shall obtain samples and test per MSMT Frequency Guide, Table 1 and 2.
- (2) Technician certification will be awarded upon satisfactory completion of an examination per MSMT 562. The certification shall be as follows:

Applications for certification shall be obtained from the Engineer a minimum of 30 days prior to producing material for the County.

The Division of Construction Contracts Administration will contact the producer and schedule an examination based on AASHTO and MSMT procedures and knowledge of MdSHA's base course plant reports and documentation.

Upon satisfactory completion of the examination, a certificate will be issued.

- (3) Supply all necessary test equipment and provide on-site facilities suitable for conducting the required tests. Off-site test facilities require approval by the Division of Construction Contracts Administration.

(c) **Reports.** The producer shall process the following reports:

- (1) MdSHA Form 43, daily, stating that the material was sampled and tested using the MdSHA's sampling and testing guidelines and meets the applicable Specifications. Make a distribution to the Engineer and to the producer's file.
- (2) MdSHA Form 88, for all additives introduced at the plant, frequency in accordance with Table 2. Make a distribution to the Engineer and to the producer's file.
- (3) Daily Plant Certification Form showing that a technician was on duty at the plant. Make a distribution to the Division of Construction Contracts Administration's project file and producer's file.
- (4) Test Worksheet, daily, for all tests performed at the plant.
- (5) Base course plant checklist daily. Make a distribution to producer's file.

915.05 CERTIFIED PRECAST CONCRETE PLANTS. The National Precast Concrete Association shall certify all plants that produce precast concrete items for the County. The producer is responsible for quality control plant operations to ensure that the material meets Specifications. The quality control process will be subject to unannounced periodic inspection by representatives of the Division of Construction Contracts Administration. The plant's certified technician shall fully participate in the inspections.

Initial Inspection. Any plant initially setting up and starting production will be subject to a comprehensive inspection to determine whether plant equipment and personnel meet all

applicable Specifications and that suitable testing facilities will be available. The County will accept signed and sealed certification by a Professional Engineer registered in the State of Maryland that the plant facilities meet all applicable Specifications; however, the Engineer shall determine final acceptance.

915.05.01 Responsibilities of the Precast Concrete Producer.

(a) Notification. Notify the Engineer at least two working days prior to producing materials for County projects.

(b) Quality Control Procedures. Quality control procedures shall include the following:

- (1) Sampling and testing shall be in accordance with Tables 1, 2, and 3 of the MSMT Sample Frequency Guide.
- (2) The method of inspecting reinforcement steel placement and forms prior to pouring concrete.
- (3) The method of curing the concrete.
- (4) The method of maintaining accurate quality control records.
- (5) Samples of documents approved by the Engineer.
- (6) Patching procedures.
- (7) Methods of preparing the concrete units for shipment.
- (8) A method of identifying each piece as tested and approved by quality control.

(c) Quality Control Plan. Submit a Quality Control Plan prior to the start of production. The plan shall indicate the following:

- (1) All precast concrete products shall meet the Standards or approved working drawings. All materials shall be from a MdSHA-approved source and meet all applicable Specifications.
- (2) The plan shall indicate how the producer intends to handle all of its materials. Certification of materials shall be as specified in the MSMT Sample Frequency Guide.
- (3) The names, qualifications, and responsibilities of a Quality Control Manager and a Quality Control Technician.

(d) Quality Control Technician. The Quality Control Technician may be approved if certified from at least one of the following:

(1) The Precast/Prestressed Concrete Institute Plant Certification Program, PCI Technician Level I, minimum.

(2) American Concrete Institute, ACI Field Technician Level I.

(e) Test Equipment and Facilities. Supply all necessary test equipment and provide County-approved facilities suitable for conducting the various tests required. The Engineer shall approve any off site test facilities.

SECTION 916 – SOIL AND SOIL-AGGREGATE BORROW

916.01 BORROW EXCAVATION. All borrow excavation shall be a soil or soil aggregate mixture and shall conform to the following:

Maximum dry density and optimum moisture content of the material shall be determined as specified in T 180, Method C unless the material has more than 35 percent retained on the No. 4 sieve, in which case Method D shall be used. Material with a maximum dry density of less than 100 lb/cu.ft. is unsatisfactory and shall not be used in embankments unless otherwise specified in the Contract Documents. Potentially expansive materials, such as steel slag, are prohibited.

Recycled Portland cement concrete or HMA pavement may be used as select borrow, capping borrow and modified borrow with the written approval of the Engineer. Recycled Portland cement concrete, recycled HMA pavement and processed contaminated soil are prohibited for use within one foot of the surface of any area to be vegetated. All recycled or re-handled materials shall meet Section TC-6.09.

916.01.01 Select Borrow. Select borrow shall conform to A-2, A-3 or A-2-4 material as specified in the Contract Documents. The maximum dry density shall not be less than 105 lb/cu.ft.

916.01.02 Capping Borrow. Capping borrow shall conform to the Select Borrow requirements except when A-3 material has less than 10 percent retained on the No. 10 sieve, at least 15 percent shall pass the No. 200 sieve. Sieve analysis shall be determined using T 88.

916.01.03 Modified Borrow. Modified borrow shall have a minimum of 50 percent retained on the No. 4 sieve, a liquid limit not greater than 30 when tested as specified in T 89, and a

plasticity index not greater than 9 when tested as specified in T 90. The maximum dry density shall not be less than 125 lb/cu.ft. A-5 material, as defined in the Contract Documents, shall not be used.

916.01.04 Common Borrow. Common borrow shall have a maximum dry density of not less than 100 lb/cu.ft.

SECTION 917 – MISCELLANEOUS PROTECTIVE COATINGS

917.01 EPOXY PROTECTIVE COATINGS FOR CONCRETE. Protective coatings shall be two component epoxy systems for use in conjunction with concrete. One component shall be a clear or pigmented condensation product of the reaction of epichlorohydrin with bisphenol A, the resin of which shall be composed of 100 percent reactive constituents. The other component shall be a clear polyamide hardener.

The producer shall submit a sample of each component for laboratory analysis. The sample shall be coded as the original sample. The original and all subsequent samples shall conform to the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Pot Life, hr min	Fed. Spec TT-C-535	8
Color	Fed. Std. 595	Gray No. 26440
Dry Film Thickness 1st coat, mil min 2nd coat, mil min	D 1005	2 3
Sagging	D 4400	Must pass test for Recommended film Thickness
Flexibility	Federal Spec TT-P-115	Must not crack, check or delaminate
Infrared Spectrogram	Equipment Manufacturer's Procedure	Each component shall match original sample
Tensile Strength, psi min	MSMT 609	400

917.02 FUSION BONDED EPOXY POWDER COATINGS FOR STEEL. M 284. The epoxy protective coating shall be a one-coat, heat curable, thermosetting powdered coating that is electrostatically applied on metal surfaces as specified. The coating color shall be bright for reinforcement steel, in order to contrast with the normal color of reinforcement and

rust (e.g. orange, red, green, yellow etc. and not brown or any color in the rust family). Reinforcement steel coated before fabrication shall have all hairline cracks and minor damage on fabrication bends patched, even if there is no bond loss. The Design Division of the Bureau of Engineering and Construction shall approve epoxy coating material.

917.02.01 Touch-Up System. Material used for the touch-up system shall be a two-part epoxy system designated and color matched for patching the epoxy coating used.

Patching material shall be available through the manufacturer of the epoxy powder. The patching material shall be fully cured one hour after application at 35 F ambient.

917.02.02 Certification. The manufacturer shall furnish certification as specified in Section GP-1.05.

917.03 FUSION BONDED POLYESTER POWDER.

917.03.01 Materials. The polyester powder shall be super durable TGIC (Triglycidyl Isocyanurate) polyester conforming to the requirements given in Section 917.03.02. The Design Division of the Bureau of Engineering and Construction shall approve the polyester powder.

917.03.02 Polyester Qualification Requirements. The following physical tests will only be required to qualify the polyester, and will not be required for certification:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Abrasion Resistance	Taber Abraser CS-10, 1000 gm load, 1000 cycles, D 1044	100 mg max weight loss
Adhesion	D 3359, Method A (Bonderite 1000 panel)	Rating 5A
Gloss	D 523, 60° initial	30 - 45 per Fed. Std 595
Hardness	D 3363	Min 2H - No gouge
Impact	D 2794	Pass 80 in·lb
Salt Spray Resistance	B 117, D 1654 1000 hr (Bonderite 1000 panel)	Table 2, Rating 7
Thickness	G 12	7 ± 2 mils
Color	E 1331	As specified in the Contract Documents from Fed. Std. 595 Color No. 20040
Infrared Spectrogram	Equipment manufacturer's procedures	Manufacturer's IR
Weather Resistance	D 4587, test condition D Test shall be conducted with a UVA lamp (340 nm peak) for 1000 hr	50 % min gloss retention
Specific Gravity	D 5965	Manufacturer's result
Chloride Permeability	A 775, A 1.3.4	<0.0001M

917.03.03 Certification. The polyester powder manufacturer shall furnish production batch certification as specified in Section GP-1.05 showing conformance to the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Infrared Spectrogram	D 2621	Match Qualification sample
Taber Abrasion Resistance, mg loss, max	D 4060	100
Specific Gravity	D 5965 (Method A)	Qualification sample ± 0.02
Color	E 1331	Match Fed. Std. 595 color no. specified in Contract Documents

917.03.04 Acceptance. Acceptance will be based on the quality control test results required on the manufacturer's certification. The coating applicator shall be responsible for reviewing certifications to ensure conformance to Section GP-1.05. The coating applicator shall also maintain a file of all reviewed certifications.

917.04 EMULSIFIED ASPHALT PROTECTIVE COATINGS FOR METAL. D 1187, Type I. Provide a thick film of emulsified asphalt as a protective coating between dissimilar

metals and on metal surfaces which will be in contact with concrete, mortar, or absorptive materials subject to wetting. Emulsified asphalt shall be asbestos-free.

SECTION 918 – TRAFFIC BARRIERS

918.00 CERTIFICATION. The manufacturer shall furnish certification as specified in Section GP-1.05.

918.01 TRAFFIC BARRIER W BEAM. Rail elements and end treatments shall conform to M 180, Type II or IV. In lieu of galvanizing, rail elements may be coated with a minimum of 5 mil dry film thickness of inorganic zinc rich primer conforming to the requirements of Section 912.02.01. The primer shall be applied as specified by the manufacturer after the rail elements are fabricated.

918.02 TRAFFIC BARRIER POSTS. Posts shall conform to ASTM A36 for steel and M 111 for galvanized coating. In lieu of galvanizing, posts may be coated with a minimum of 5 mil dry film thickness of inorganic zinc rich primer conforming to the requirements of Section 912.02.01. The primer shall be applied as specified by the manufacturer after the posts are fabricated.

918.03 HARDWARE FOR TRAFFIC BARRIERS. Hardware for traffic barriers shall conform to ASTM A36 for quality of steel and M 232 for galvanized coating.

918.04 TIMBER RAIL AND POSTS. Timber rail and posts shall conform to M 168.

918.05 WIRE ROPE. Wire rope shall conform to Federal Specification RR-W-410, Type I, General Purpose, Class 2, 6 by 19, improved plow steel, fiber core. The individual wire strands shall have a zinc coating of 0.8 oz/sq.ft. when tested as specified in T 65.

SECTION 919 – RESERVED

SECTION 920 – LANDSCAPING MATERIALS

920.01 SOILS. Topsoil, Subsoil, and Bioretention Soil Mix shall conform to requirements of this section. Soils shall be sampled, tested and approved per specifications of MSMT 356 or by other approved tests or laboratories. Soils shall be amended as specified by the Nutrient Management Plan (NMP).

920.01.01 Salvaged Topsoil. The surface material classified as topsoil that is removed from the project and stored for reuse. Salvaged topsoil shall conform to the following:

COMPOSITION - SALVAGED TOPSOIL					
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT			
Prohibited Weeds	—	Free of seed or viable parts of shattercane, Johnsongrass, Canada thistle, bull thistle, plumeless thistle, musk thistle, and common reed when inspected before transportation.			
Debris	—	1.0 % or less by weight of cement, concrete, asphalt, crushed gravel or construction debris when inspected.			
Grading Analysis	R 58	Sieve Size		Passing by Weight Minimum %	
		2 in.		100	
		No. 4		90	
		No. 10		80	
Textural Analysis	T 88	Particle		% Passing by Weight	
		Size	mm	Minimum	Maximum
		Sand	2.0 – 0.050	20	75
		Silt	0.050 – 0.002	10	60
Clay	less than 0.002	5	30		
Soil pH	D 4972	pH of 4.8 to 7.4. Apply limestone to soil with pH 4.8 to 6.1 per NMP. Apply sulfur or iron sulfate to soil with pH 7.1 to 7.4 per NMP.			
Organic Matter	T 194	1.0 to 8.0 % OM by weight. Apply compost to soil with 1.0 to 1.7% OM per NMP to achieve at least 2.0% OM.			
Nutrient Content	Mehlich-3	County will assess. Apply fertilizer per NMP for nitrogen requirement and optimum fertility index values (FIV) for phosphorus and potassium.			
Soluble Salts	EC1:2 (V:V)	800 ppm or less. Apply gypsum to soil with 500 to 800 ppm per NMP.			
Harmful Materials	—	Shall not contain substances in concentrations that are harmful to human health, water quality, or plant growth. Industrial waste such as ash, slag, raw sludge, dredge spoil, or similar materials shall not be soil components.			

920.01.02 Furnished Topsoil. A natural, friable, surface soil that is uniform in color and texture, and not derived from the project.

Furnished topsoil shall conform to the following:

(a) Composition.

COMPOSITION - FURNISHED TOPSOIL		
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT
Prohibited Weeds	—	Free of seed and viable parts of species in Section 920.01.01, and viable parts of Bermudagrass, quackgrass, and yellow nutsedge.
Debris	—	Section 920.01.01
Grading Analysis	R 58	Section 920.01.01
Textural Analysis	T 88	Section 920.01.01

COMPOSITION - FURNISHED TOPSOIL		
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT
Soil pH	D 4972	pH of 5.2 to 7.4. Apply limestone to soil with pH 5.2 to 6.1 per NMP. Apply sulfur or iron sulfate to soil with pH 7.1 to 7.4 per NMP.
Organic Matter	T 194	Section 920.01.01
Nutrient Content	Mehlich-3	Section 920.01.01
Soluble Salts	EC1:2 (V:V)	500 ppm or less.
Harmful Materials	—	Section 920.01.01

(b) Storage. Soil shall be a homogenous mixture stored at a specific, identifiable site in a stockpile constructed as specified in Section 701.03.02(c).

(c) Approval. Ensure that MdSHA Form 27B has been completed and that a source of supply letter for the soil has been submitted and approved. Tests shall be completed and approval granted before soil is delivered.

(d) Certification and Delivery. Certification shall be submitted that the soil is delivered from an approved stockpile. Certification shall accompany the first load of soil delivered each day.

920.01.03 RESERVED.

920.01.04 RESERVED.

920.01.05 Bioretention Soil Mix (BSM). A homogeneous mixture composed by loose volume of 5 parts Coarse Sand, 3 parts Base Soil, and 2 parts Fine Bark. BSM shall conform to the following:

(a) Components. Components of BSM shall be sampled, tested and approved before mixing as follows:

(1) Coarse Sand. MSMT 356. Coarse Sand shall be washed silica sand or crushed glass that conforms to ASTM Fine Aggregate C 33. Coarse Sand shall include less than 1% by weight of clay or silt size particles, and less than 5% by weight of any combination of diabase, greystone, calcareous or dolomitic sand.

(2) Base Soil. Base Soil shall be tested and certified by the producer to conform to the following requirements:

COMPOSITION - BASE SOIL					
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT			
Prohibited Weeds	—	Free of seed and viable plant parts of species in Sections 920.06.02(a), (b), and (c) when inspected.			
Debris	—	No observable content of cement, concrete, asphalt, crushed gravel or construction debris when inspected.			
Grading Analysis	R 58	Sieve Size		Passing by Weight Minimum %	
		2 in.		100	
		No. 4		90	
		No. 10		80	
Textural Analysis	T 88	Particle		% Passing by Weight	
		Size	mm	Minimum	Maximum
		Sand	2.0 – 0.050	50	85
		Silt	0.050 – 0.002	5	45
Clay	less than 0.002	5	10		
Soil pH	D 4972	pH of 5.7 to 6.9.			
Organic Matter	T 194	1.0 to 10.0 % by weight.			
Soluble Salts	EC1:2 (V:V)	500 ppm or less.			
Harmful Materials	—	Section 920.01.01			

(3) Fine Bark. Fine Bark shall be the bark of hardwood trees that is milled and screened to a uniform particle size of 2 in. or less. Fine Bark shall be composted and aged for 6 months or longer, and be free from sawdust and foreign materials.

A 1 to 2 lb sample of Fine Bark shall be submitted to the Engineer for examination.

(b) Composition. BSM shall be sampled and tested according to the requirements of MSMT 356 and conform to the following:

COMPOSITION- BIORETENTION SOIL MIX (BSM)					
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT			
Weeds	—	Free of seed and viable plant parts of species in Sections 920.06.02(a), (b), and (c) when inspected.			
Debris	—	Section 920.01.05(a)(2)			
Textural Analysis	T 88	Particle		% Passing by Weight	
		Size	mm	Minimum	Maximum
		Sand	2.0 – 0.050	55	85
		Silt	0.050 – 0.002	—	20
Clay	less than 0.002	1	8		
Soil pH	D 4972	pH of 5.7 to 7.1.			
Organic Matter	T 194	Minimum 1.5 % by weight.			

COMPOSITION- BIORETENTION SOIL MIX (BSM)						
TEST PROPERTY	TEST METHOD	TEST VALUE AND AMENDMENT				
Nutrient Analysis and Soluble Salts	Mehlich-3	Concentration				
		Element	Minimum		Maximum	
			ppm	FIV	ppm	FIV
		Calcium (Ca)	32	25	no limit	no limit
		Magnesium (Mg)	15	25	no limit	no limit
		Phosphorus (P)	18	25	92	100
	Potassium (K)	22	25	no limit	no limit	
Sulfur (SO ₄)	25	n/a	no limit	no limit		
	EC1:2 (V:V)	Soluble Salts	40	n/a	500	n/a
Harmful Materials	—	Section 920.01.01				

- (c) **Amendment or Failure.** BSM that does not conform to composition requirements for pH or nutrient analysis shall be amended as specified by the NMP. BSM that exceeds maximum phosphorus concentration or fails other composition requirements will not be accepted, and shall not be delivered or used as BSM.
- (d) **Storage.** Section 920.01.02(b). BSM shall be stored in a stockpile that is protected from weather under tarp or shed. BSM stored for 6 months or longer shall be re-sampled, re-tested, and re-approved before use.
- (e) **Approval.** Section 920.01.02(c).
- (f) **Certification and Delivery.** Section 920.01.02(d).

920.02 SOIL AMENDMENTS.

920.02.01 Limestone. Limestone shall be an approved agricultural product manufactured and labeled for increasing soil pH. Limestone shall contain at least 85 percent calcium and magnesium carbonates. Dolomitic limestone shall contain at least 10 percent magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates.

Limestone shall be supplied as a fine powder, or as pellets produced from fine powder, that conforms to the following:

LIMESTONE GRADING ANALYSIS	
SIEVE Size Number	PASSING BY WEIGHT Minimum %
10	100
20	98
100	50

920.02.02 Sulfur. Sulfur shall be an approved agricultural product manufactured and labeled for reducing soil pH. Sulfur labeled as a fertilizer may also be used to supply sulfur as a plant nutrient. Sulfur shall be supplied as a fine powder or pelletized powder with a minimum purity of 90 percent elemental sulfur.

920.02.03 Iron Sulfate. Iron sulfate shall be an approved agricultural product manufactured and labeled for reducing soil pH. Iron sulfate labeled as a fertilizer may also be used to supply sulfur or iron as a plant nutrient. Iron sulfate shall be supplied as a fine powder or pelletized powder with a minimum purity of 15 percent water soluble iron derived from ferrous sulfate.

920.02.04 Gypsum. Gypsum shall be an approved agricultural product manufactured and labeled as an aid for improving soil structure and removing soil soluble salts, or as a fertilizer to supply calcium and sulfate. Gypsum shall be supplied as a fine powder or pelletized powder with a minimum purity of 68 percent calcium sulfate dihydrate.

920.02.05 Compost.

(a) Compost Types. Compost shall be either Type A (biosolids) or Type B (source-separated), and will be subject to approval by the Engineer as follows:

(1) Biosolids Compost (Type A). Type A Compost shall be approved for distribution by the Maryland Department of the Environment (MDE).

(2) Source-Separated Compost (Type B). Type B Compost shall be produced by a compost operator who is certified by the Maryland Department of Agriculture (MDA).

Type B Compost shall be tree leaf compost or non-tree leaf compost. Type B Compost produced from lawn clippings shall be tested for contaminants in conformance with Maryland law and regulations.

(b) Stability. Compost shall be biologically mature and no longer able to reheat to thermophilic temperatures.

(c) pH. Compost shall have a pH of 6.0 to 7.5 except when specified in Sections 710 and 711 where it shall have a pH of 6.0 to 7.0.

(d) Soluble Salts. Type A Compost shall have a soluble salt concentration less than 10.0 mmhos/cm, and Type B Compost shall have soluble salts concentration less than 5.0 mmhos/cm.

(e) Moisture. Compost shall have a moisture content of 30 to 55 percent.

(f) Particle Size and Grading. Compost shall be screened so that it has a uniform particle size of 0.5 in. or less, with grading analysis as follows:

COMPOST GRADING ANALYSIS	
SIEVE SIZE mm	PASSING BY VOLUME Maximum %
4.75	90
0.425	25
0.075	2.2

920.02.06 Peat Moss. A milled sphagnum peat moss with negligible woody substances.

920.02.07 Aged Pine Bark Fines. Derived from the bark of pine trees that have been composted and milled to a fineness approved for use by the Engineer.

920.02.08 Water Absorbent Gel. A cross linked polyacrylamide agricultural product used to maintain moisture around bare root plants and as a soil conditioner. Formulas used shall conform to the manufacturer's recommendations.

920.03 FERTILIZERS.

920.03.01 Composition. Fertilizers shall be commercial grade labeled for use as agricultural fertilizer, and shall conform to Federal and Maryland State regulations and the Standards of the Association of Official Analytical Chemists. All analyses are subject to approval by the Engineer prior to application.

Standard and Special Fertilizers shall be the following:

(a) Standard Fertilizer. Standard fertilizers shall be produced of ingredients, analysis, and composition as follows:

(1) Ingredients. One or more of the following:

FERTILIZER INGREDIENTS	
ammonium nitrate	polymer coated urea
ammonium sulfate	potassium chloride
biosolids	potassium sulfate (SOP)
diammonium phosphate (DAP)	sulfur coated urea
isobutylidene diurea	triple super phosphate
methylene urea	urea
monoammonium phosphate (MAP)	ureaform (UF)

(2) Analysis and Composition. Standard fertilizers shall contain nitrogen (N), phosphorus (P), potassium (K), and sulfate (SO₄) derived from ingredients above.

STANDARD FERTILIZER ANALYSIS and COMPOSITION		
FERTILIZER	USE	SECTION
0-0-50 SOP ^a	Supply P and SO ₄	705, 706, 707, 708, others
5-20-20 ^b	Refertilization	705
11-52-0 MAP ^a	Supply N and P	706, 707, others
15-30-15 ^b	Temporary seeding	704
20-16-12 (83% UF with MAP and SOP) ^c	Turfgrass establishment and other seeding	705, 706, 707, 708, 709
38-0-0 UF ^a	Slow-release N	705, 706, 707, 708, others

^a Purity shall be at least 98% UF, MAP, or SOP as indicated.

^b Shall be a mixture of any ingredients listed in Section 920.03.01(a)(1) with no more than 2% by weight of any combination of other materials.

^c Shall be a mixture of UF, MAP, and SOP with no more than 2% by weight of any combination of other materials.

(b)Special Fertilizers. Special fertilizers shall be of ingredients, analysis, and composition as follows:

(1) Ingredients. Special fertilizers shall provide label analysis guaranteeing nitrogen, phosphorus, and potassium from ingredients in (a) and also include plant micronutrients, coatings, or materials to augment their performance.

(2) Analysis and Composition. As follows:

SPECIAL FERTILIZER ANALYSIS and COMPOSITION		
FERTILIZER*	USE	SECTION
14-14-14 Polymer-coated with minor nutrients	Plant installation.	710, 711
20-10-5 21 to 23 grams per tablet. 13% water insoluble and 7% water soluble N, with minor nutrients	Tree, shrub, vine installation.	710
20-20-20 Water soluble powder with minor nutrients	Fertilizer solution application after plant installation.	710, 711, others

* Shall be a mixture of any ingredients listed in Sections 920.03.01(a)(1) and (b)(1) with no more than 5% by weight of any combination of other materials.

920.04 MULCHES. Materials used as mulch shall have a uniform texture and be free from foreign materials or concentrations of metals, chemicals, or other substances that are harmful to human health, water quality, or plant growth.

920.04.01 Straw Mulch. Shall consist of thoroughly threshed stems and leaves of barley, oats, rye, and wheat.

Straw mulch shall be in an air-dry condition suitable for application with a mulch blower or other equipment.

Straw mulch shall be visually inspected to ensure it is free of objectionable quantities of mold, foreign substances, and weed seeds.

920.04.02 Wood Cellulose Fiber Mulch. A uniformly processed wood product that is able to form a homogeneous slurry with seed, fertilizer, and other materials under agitation with water.

The fiber shall perform satisfactorily in hydraulic seeding equipment without clogging or damaging the system. The slurry shall contain a green dye to provide easy visual inspection for uniformity of application.

The manufacturer shall furnish certification as specified in Section GP-1.05 of the Technical Association of Pulp and Paper Industry (TAPPI) in conformance with the following:

WOOD CELLULOSE FIBER	
TEST PROPERTY	TEST VALUE
Particle Length	Approx. 0.5 in.
Particle Thickness	Approx. 0.063 in.
Net Dry Weight Content	Minimum as stated on bag
pH, TAPPI Standard T 509,	4.0 – 8.5
Ash Content, TAPPI Standard T 413	7.0% maximum
Water Holding Capacity	90% minimum

The material shall be delivered in packages of uniform weight, which shall not exceed 75 lb net weight and shall bear the name of the manufacturer, the net weight, and a supplemental statement of the net weight content.

920.04.03 Shredded Hardwood Bark (SHB) Mulch. Shall consist of natural bark derived from hardwood trees that has been milled and screened to a maximum 4 in. particle size.

SHB mulch shall contain negligible quantities of sawdust or other non-bark woody materials.

920.04.04 Composted Wood Chip (CWC) Mulch. Shall consist of natural wood mechanically reduced to a maximum size of 2 x 2 x 0.5 in. by a chipping machine before being composted.

Grading analysis of CWC mulch shall be as follows:

COMPOSTED WOOD CHIP MULCH	
SIEVE SIZE in.	PASSING BY VOLUME Maximum %
2	100
1	30
0.5	10

920.05 SOIL STABILIZATION MATTING.

920.05.01 Soil Stabilization Matting (SSM). SSM products shall be selected from the MdSHA Office of Materials Technology’s *Qualified Products List for Soil Stabilization Matting Manufacturers*.

SSM shall consist of machine-produced matting of uniform thickness, weave, or distribution of fibers supplied in rolls at least 40 in. wide. SSM shall be smolder resistant.

The chemical components shall be nonleaching, nontoxic to vegetation and germinating seed, and noninjurious to the skin. SSM shall conform to the following:

SOIL STABILIZATION MATTING				
TEST PROPERTY and METHOD	TYPE A	TYPE B	TYPE C	TYPE D
Functional Longevity	Degradable; 24 months	Non-degradable; Permanent	Non-degradable; Permanent	Degradable; 48 months
Matting Fiber	Excelsior	Non-woven; synthetic, UV-stabilized	Synthetic lattice; easily soil infilled and compacted.	Woven coir
Netting on Top and Bottom	Degradable, synthetic	Non-degradable synthetic; UV-stabilized	—	—
Netting Opening	No more than 2.0 x 1.0 in.	No more than 0.75 x 0.75 in.	—	—
Stitching, Thread, and Spacing	Degradable, no more than 4.0 in. apart	Non-degradable, UV-stabilized, synthetic, no more than 4.0 in. apart	—	—
Thickness D 6525	At least 0.25 in.	At least 0.30 in.	At least 0.50 in.	At least 0.30 in.
Weight D 6475	At least 9.6 oz per sq.yd.	At least 10.0 oz per sq.yd.	At least 7.0 oz per sq.yd.	At least 19.0 oz per sq.yd.
Tensile Strength (MD) D 6818	At least 6.25 lb per in.	At least 12.5 lb per in.	At least 14.6 lb per in.	
Tensile Strength (TD) D 6818	At least 4.7 lb per in.	At least 12.5 lb per in.	At least 14.6 lb per in.	

SOIL STABILIZATION MATTING				
TEST PROPERTY and METHOD	TYPE A	TYPE B	TYPE C	TYPE D
Tensile Strength > 500 hr. exp. D 4355				
Light Penetration D 6567				
Porosity or Open Area				
Soil Loss Ratio at 2 in. per hr. for 30 min. D 6459				
Shear for 0.5 in. soil loss D 6460				

920.05.02 Fasteners for Soil Stabilization Matting and Turfgrass Sod. Fasteners marked 'X' shall be used as specified in Section 709.03.05 and conform to the following:

(a) Wood Peg.

WOOD PEG. Wood, biodegradable, Untreated; single leg is driven into the soil so that wider top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
Approx. 6 in. long, 3/8 in. thick; top 1 in. wide, tapered to base.	X	X		

(b) T-Head Pin.

T-HEAD PIN. Molded plastic; biodegradable. Single leg with barbs is driven into the soil so that molded T-Head top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
Approx. 6 in. long, 3/8 in. thick; head 1 in. wide.	X	X		

(c) Circle-Top Pin.

CIRCLE-TOP PIN. Steel wire; single leg is driven into the soil so that coil or loop top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
11 gauge; leg 6 in. long.	X	X		
11 gauge; leg 8 in. long.	X	X		

(d) Round-Head Pin.

ROUND-HEAD PIN. Molded plastic; biodegradable. Single leg with barbs is driven into the soil so that molded disk top is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
Approx. 6 in long; head 1 in. dia.	X	X		
Approx. 8 in long; head 1 in. dia.	X	X		

(e) U-Shape Staple.

U-SHAPE STAPLE. Steel wire; two main legs are driven into the soil so that top of staple is flush with turfgrass sod and SSM.	Turfgrass Sod	Soil Stabilization Matting		
		Type A	Type B	Type C and D
11 gauge bent into U shape; legs 6 in. long; top 1 to 1-1/2 in. wide.	X	X		
8 gauge bent into U shape; legs 8 in. long; top 1 to 1-1/2 in. wide.	X	X	X	X
8 gauge bent into U shape.; legs 12 in. long; top 1 to 1-1/2 in. wide			X	X

(f) Fabric Pin.

FABRIC PIN. Steel nail; single leg is driven into the soil so that steel washer top is flush with SSM.	Turfgrass Sod	Soil Stabilization Matting		
		TYPE A	Type B	Type C and D
11 gauge approx. 12 in. long.			X	X
3/16 in. approx 18 in. long.			X	X

920.06 SEED AND TURFGRASS SOD STANDARDS.

920.06.01 Names and Naming. The authority for common and scientific names shall be the USDA NRCS, The Plants Database website at <http://plants.usda.gov>. Cultivar names shall be those of the registered cultivar.

Plant and seed identification, tags, and labels shall correspond to the common name and scientific name of the species in The Plants Database. The Engineer shall resolve any conflict in names or naming.

920.06.02 Prohibited Weeds.

(a) Weeds Prohibited in Turfgrass Sod and SHA Seed Mixtures. Turfgrass Sod, SHA Turfgrass Seed Mix, SHA Temporary Seed Mix, and Additive Seed shall be free from seed or viable parts of the following species:

WEEDS PROHIBITED IN TURFGRASS SOD AND SHA SEED MIXTURES	
COMMON NAME	SCIENTIFIC NAME
annual bluegrass	<i>Poa annua</i> L.
balloonvine	<i>Cardiospermum halicacabum</i> L.
Bermudagrass	<i>Cynodon dactylon</i> (L.) Pers.
Canada Thistle	<i>Cirsium arvense</i> (L.) Scop.
Carolina horsenettle	<i>Solanum carolinense</i> L.
common corncockle	<i>Agrostemma githago</i> L.
common reed = phragmites	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.
crested anoda = spurred anoda	<i>Anoda cristata</i> (L.) Schltld.
dodder	<i>Cuscuta spp.</i> L.
field bindweed	<i>Convolvulus arvensis</i> L.
Japanese bristlegrass = giant foxtail	<i>Setaria faberi</i> Herrm.
Java-bean = sicklepod	<i>Senna obtusifolia</i> (L.) Irwin and Barneby
Johnsongrass	<i>Sorghum halepense</i> (L.) Pers. and hybrids
meadow garlic = wild onion	<i>Allium canadense</i> L.
plumeless thistle	<i>Carduus</i> L.
quackgrass	<i>Elytrigia repens</i> (L.) Gould
Rough cocklebur	<i>Xanthium strumarium</i> L.
serrated tussock	<i>Nassella trichotoma</i> (Nees) Hack.
wild garlic	<i>Allium vineale</i> L.
yellow nutsedge	<i>Cyperus esculentus</i> L.

(b) Weeds Prohibited in Meadow and Wildflower Seed. Meadow and Wildflower Seed shall be free of species listed in (a) and the following species:

WEEDS PROHIBITED IN MEADOW and WILDFLOWER SEED	
COMMON NAME	SCIENTIFIC NAME
asiatic tearthumb = mile-a-minute	<i>Polygonum perfoliatum</i> L.
burdock and related species	<i>Arctium</i> L.
canarygrass and related species	<i>Phalaris</i> L.
common wormwood = mugwort	<i>Artemisia vulgaris</i> L. var. <i>vulgaris</i>
dogbane and related species	<i>Apocynum</i> L.
eastern poison ivy	<i>Toxicodendron radicans</i> (L.) Kuntze
fig buttercup = lesser celandine	<i>Ranunculus ficaria</i> L. var. <i>bulbifera</i> Marsden-Jones
garlic mustard	<i>Alliaria petiolata</i> (M. Bieb.) Cavara and Grande
Giant hogweed	<i>Heracleum mantegazzianum</i> Sommier and Levier

WEEDS PROHIBITED IN MEADOW and WILDFLOWER SEED	
COMMON NAME	SCIENTIFIC NAME
Japanese honeysuckle, Tatarian honeysuckle and related species	<i>Lonicera</i> L.
Japanese Knotweed	<i>Polygonum cuspidatum</i> Siebold and Zucc.
lesser knapweed = spotted knapweed	<i>Centaurea nigra</i> L.
multiflora rose	<i>Rosa multiflora</i> Thunb.
Nepalese browntop = Japanese stiltgrass	<i>Microstegium vimineum</i> (Trin.) A. Camus
purple loosestrife and related species	<i>Lythrum</i> L.
poison hemlock	<i>Conium maculatum</i> L.
silvergrass and related species	<i>Miscanthus</i> Andersson
thistle and related species	<i>Cirsium</i> Mill., <i>Onopordum</i> L.

- (c) **Weeds Prohibited in Shrub Seed.** Shrub Seed shall be free of species listed in (a) and (b) and the following species:

WEEDS PROHIBITED IN SHRUB SEED	
COMMON NAME	SCIENTIFIC NAME
common buckthorn	<i>Rhamnus cathartica</i> L.
Burningbush	<i>Euonymus alatus</i> (Thunb.) Siebold
Japanese barberry	<i>Berberis thunbergii</i> DC.
oriental bittersweet	<i>Celastrus orbiculatus</i> Thunb.
privet, etc.	<i>Ligustrum</i> L.
oleaster; Russian olive, autumn olive, related species	<i>Elaeagnus</i> L.
tree of heaven	<i>Ailanthus altissima</i> (Mill.) Swingle

920.06.03 Turfgrass Sod. Turfgrass Sod shall be Maryland Certified Sod and comply with the Maryland Turfgrass Law and Regulations of the State of Maryland.

- (a) Each load of turfgrass sod shall bear a Maryland State Certified Label and be in good health at the time of delivery.
- (b) Turfgrass sod shall be field grown in the State of Maryland and be sufficiently knitted when harvested to resist breakage under normal handling.
- (c) Prior to harvest, Tall Fescue sod shall be mowed to a height of 2.0 to 3.5 in. Bermudagrass sod shall be mowed from 0.75 to 1.0 in. height.
- (d) Turfgrass sod shall be machine cut in strips at least 14 in. wide.

- (e) Turfgrass sod shall be uniform thickness of 0.75 to 1.25 in., excluding top growth, with thatch thickness less than 3/8 in.

920.06.04 Approved Cultivars. Refer to ‘*Specifications for Seed and Seed Mixes*’, a list of cultivars of species approved for use in seed mixes and specifications maintained by the MdSHA Landscape Operations Division. Only cultivars included on that list may be used. When no cultivar is specified, any common type cultivar of the species may be provided.

920.06.05 Seed Testing and Sampling. Seed shall comply with the Maryland Seed Law and Regulations of the State of Maryland. Seed suppliers shall assume charges for seed inspections and testing.

(a) Mixtures and Additive Seed. Turfgrass Seed Mix, Special Purpose Seed Mix, Temporary Seed Mix, and certified cultivars of Additive Seed shall be sampled and tested by an inspector of the Maryland Department of Agriculture, Turf and Seed Section (MDA) for percent purity, percent germination, percent weed seed, noxious weed content, and conform to MDA Standards for Maryland Certified Seed. Seed Mixtures used in Baltimore County shall carry MDA Certified Seed tags that show the purity, germination, weed seed, and noxious weed seed content. Seed mixtures certified as SHA seed mixtures may be used in Baltimore County as applicable.

(b) Unmixed Seed. Seed supplied for use as Meadow Seed or Shrub Seed shall be supplied in containers of a single species, unmixed. Each species shall be tested for purity, germination, and weed seed; and carry tags provided by the grower or distributor that indicate the test results. Seed shall be accompanied by MDA documentation to indicate the seed conforms to requirements when it is mixed or seeded.

920.06.06 Standards for Seed Species. Seed supplied in lots of individual species or used to produce mixes shall conform to the requirements of this section for minimum percent germination, minimum purity, and maximum percent of weed seed.

Subject to review and approval by the Engineer, meadow or shrub seed that does not conform to germination or purity requirements may be used. The seed will be subject to use at increased seeding rates or measures to compensate for reduced substandard seed purity or germination.

(a) SHA Turfgrass Seed Mix and SHA Special Purpose Seed Mix. Species included in SHA Turfgrass Seed Mix and SHA Special Purpose Seed Mix shall be MDA Certified Seed of approved cultivars and conform to the following requirements for minimum percent purity, maximum percent weed seed, and minimum percent germination:

TURFGRASS SEED SPECIES			
COMMON NAME, and SCIENTIFIC NAME	PURITY Min %	WEED Max %	GERM Min %
Chewings fescue <i>Festuca rubra</i> L. ssp. <i>fallax</i> (Thuill.) Nyman	98	0.5	85
red fescue <i>Festuca rubra</i> L. ssp. <i>rubra</i>	98	0.5	85
hard fescue <i>Festuca brevipila</i> Tracey	98	0.5	85
Kentucky bluegrass <i>Poa pratensis</i> L. ssp. <i>pratensis</i>	95	0.4	80
perennial ryegrass <i>Lolium perenne</i> L. ssp. <i>perenne</i>	98	0.5	85
sheep fescue <i>Festuca ovina</i> L.	98	0.5	85
tall fescue <i>Schedonorus phoenix</i> (Scop.) Holub = <i>Festuca elatior</i> L.	98	0.5	85

(b) Temporary and Grass Additive Seed. Species included in Temporary Seed Mix, or used as Additive Seed with Turfgrass Seed Mix or Special Purpose Seed Mix shall conform to the following requirements for minimum percent purity, maximum percent weed seed, and minimum percent germination:

TEMPORARY and GRASS ADDITIVE SEED SPECIES			
COMMON NAME, and SCIENTIFIC NAME	PURITY Min %	WEED Max %	GERM Min %
cereal rye <i>Secale cereale</i> L.	98	0.1	85
common barley, winter type <i>Hordeum vulgare</i> L.	98	0.3	85
common oat, winter type <i>Avena sativa</i> L.	98	0.5	85
common wheat, winter type <i>Triticum aestivum</i> L.	98	0.1	85
Italian ryegrass = annual ryegrass <i>Lolium perenne</i> L. ssp. <i>multiflorum</i> (Lam.) Husnot	95	0.3	85
foxtail bristlegrass = foxtail millet <i>Setaria italica</i> (L.) P. Beauv.	99	0.1	80
Lehmann lovegrass <i>Eragrostis lehmanniana</i> Nees	98	0.5	80
weeping lovegrass <i>Eragrostis curvula</i> (Schrad.) Nees	98	0.5	80

(c) Legume Additive Seed. Species used as Additive Seed with SHA Turfgrass Seed Mix or SHA Special Purpose Seed Mix shall be MDA Certified Seed when cultivars are specified and conform to the following requirements for minimum percent purity, maximum percent weed seed, minimum percent germination, and maximum percent hard seed.

LEGUME ADDITIVE SEED SPECIES				
COMMON NAME, SCIENTIFIC NAME, and CULTIVARS	PURITY Min	WEED Max %	GERM Min %	HARD Max %
birdsfoot trefoil <i>Lotus corniculatus</i> L. var. <i>corniculatus</i>	98	0.5	85	20
crownvetch <i>Securigera varia</i> (L.) Lassen	98	0.5	80	30
sericea lespedeza <i>Lepedeza cuneata</i> (Dum. Cours.) G. Don cv. Interstate or Interstate 76	98	0.5	85	20

Note: Minimum percent germination includes all seed identified as hard seed.

(d)Meadow Forb Seed. Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

- (1) Purity.** Weed and/or other crop seed content shall be 2.5 percent or less by weight. After review and approval by the Engineer, seed that does not conform to this specification may be used at increased seeding rates, or with measures to compensate for increased weed or crop seed content.
- (2) Origin.** Seed shall either be collected from native sources in USDA Hardiness Zone 5b, 6a, 6b and 7a in the States of Maryland, Pennsylvania, New York, New Jersey, Delaware, Virginia, West Virginia, or North Carolina, or shall be grown and produced from seed certified to have been collected from sites in the USDA Hardiness Zones of those States. After review and approval by the Engineer, seed that does not conform to origin requirements may be used.
- (3) Species.** Seed shall conform to the following species, subspecies and varieties:

MEADOW FORB SEED SPECIES	
COMMON NAME	SCIENTIFIC NAME
Allegheny monkeyflower = square stem monkeyflower	<i>Mimulus ringens</i> L. var. <i>ringens</i>
bearded beggarticks = showy tickseed	<i>Bidens aristosa</i> (Michx.) Britton
blackeyed Susan	<i>Rudbeckia hirta</i> L. var. <i>hirta</i> <i>Rudbeckia hirta</i> L. var. <i>pulcherrima</i> Farw.
browneyed Susan	<i>Rudbeckia triloba</i> L. var. <i>triloba</i> <i>Rudbeckia triloba</i> L. var. <i>pinnatiloba</i> Torr. and A. Gray
common boneset	<i>Eupatorium perfoliatum</i> L. var. <i>perfoliatum</i>
common evening primrose	<i>Oenothera biennis</i> L.
crimsoneyed rose mallow	<i>Hibiscus moscheutos</i> L.
eastern purple coneflower	<i>Echinacea purpurea</i> (L.) Moench
flat-top goldenrod = grass-leaved goldenrod	<i>Euthamia graminifolia</i> (L.) Nutt. <i>Euthamia graminifolia</i> (L.) Nutt. var. <i>graminifolia</i> <i>Euthamia graminifolia</i> (L.) Nutt. var. <i>hirtipes</i> (Fernald) C.E.S. Taylor and R.J. Taylor
gray goldenrod	<i>Solidago nemoralis</i> Aiton var. <i>nemoralis</i>
lanceleaf tickseed = lanceleaf coreopsis	<i>Coreopsis lanceolata</i> L.

MEADOW FORB SEED SPECIES	
COMMON NAME	SCIENTIFIC NAME
Maryland senna	<i>Senna marilandica</i> (L.) Link
Maximilian sunflower	<i>Helianthus maximiliani</i> Schrad.
New England aster	<i>Symphyotrichum novae-angliae</i> (L.) G.L. Nesom
New York aster	<i>Symphyotrichum novi-belgii</i> (L.) G.L. Nesom var. <i>elodes</i> (Torr. and A. Gray) G.L. Nesom <i>Symphyotrichum novi-belgii</i> (L.) G.L. Nesom var. <i>novi-belgii</i> <i>Symphyotrichum novi-belgii</i> (L.) G.L. Nesom var. <i>villicaule</i> (A. Gray) J. Labrecque and L. Brouillet
New York ironweed	<i>Vernonia noveboracensis</i> (L.) Michx.
partridge pea	<i>Chamaecrista fasciculata</i> (Michx.) Greene <i>Chamaecrista fasciculata</i> (Michx.) Greene var. <i>fasciculata</i> <i>Chamaecrista fasciculata</i> (Michx.) Greene var. <i>macrosperma</i> (Fernald) C.F. Reed
king of the meadow = tall meadow rue	<i>Thalictrum pubescens</i> Pursh
seedbox	<i>Ludwigia alternifolia</i> L.
smooth blue aster	<i>Symphyotrichum laeve</i> (L.) A. Löve and D. Löve var. <i>laeve</i> <i>Symphyotrichum laeve</i> (L.) A. Löve and D. Löve var. <i>concinnum</i> (Willd.) G.L. Nesom
smooth oxeye = ox-eye sunflower	<i>Heliopsis helianthoides</i> (L.) Sweet var. <i>helianthoides</i> <i>Heliopsis helianthoides</i> (L.) Sweet var. <i>scabra</i> (Dunal) Fernald
spotted trumpetweed = spotted joe pye weed	<i>Eupatoriadelphus maculatus</i> (L.) King and H. Rob. var. <i>maculatus</i>
stiff goldenrod	<i>Oligoneuron rigidum</i> (L.) Small var. <i>rigidum</i>
sundial lupine = wild blue lupine	<i>Lupinus perennis</i> L. ssp. <i>perennis</i> <i>Lupinus perennis</i> L. ssp. <i>perennis</i> var. <i>perennis</i> <i>Lupinus perennis</i> L. ssp. <i>perennis</i> var. <i>occidentalis</i> S. Watson
swamp milkweed	<i>Asclepias incarnata</i> L. <i>Asclepias incarnata</i> L. ssp. <i>incarnata</i> <i>Asclepias incarnata</i> L. ssp. <i>pulchra</i> (Ehrh. ex Willd.) Woodson
swamp sunflower = narrow-leaved sunflower	<i>Helianthus angustifolius</i> L.
swamp verbena = blue vervain	<i>Verbena hastata</i> L. var. <i>hastata</i>
talus slope penstemon = tall white beardtongue	<i>Penstemon digitalis</i> Nutt. ex Sims
trumpetweed = joe pye weed	<i>Eupatoriadelphus fistulosus</i> (Barratt) King and H. Rob.
wild bergamot	<i>Monarda fistulosa</i> L. ssp. <i>fistulosa</i> <i>Monarda fistulosa</i> L. ssp. <i>fistulosa</i> var. <i>mollis</i> (L.) Benth. <i>Monarda fistulosa</i> L. ssp. <i>fistulosa</i> var. <i>rubra</i> A. Gray <i>Monarda fistulosa</i> L. ssp. <i>brevis</i> (Fosberg and Artz) Scora, ined.

(e) **Meadow Grass, Sedge, and Rush Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

- (1) **Purity.** Refer to Section 920.06.06(d)(1). Grasses with awns shall be debearded or deawned.
- (2) **Origin.** Refer to Section 920.06.06(d)(2). Cultivars may be produced in any state east of the Mississippi River.
- (3) **Species.** Seed shall conform to the following species, subspecies, varieties, and cultivars:

MEADOW GRASS, SEDGE and RUSH SEED SPECIES	
COMMON NAME and CULTIVARS	SCIENTIFIC NAME
big bluestem cv. Niagara	<i>Andropogon gerardii</i> Vitman
longhair sedge = bristly sedge	<i>Carex comosa</i> Boott
broomsedge bluestem = broomsedge	<i>Andropogon virginicus</i> L. <i>Andropogon virginicus</i> L. var. <i>virginicus</i> <i>Andropogon virginicus</i> L. var. <i>decipiens</i> C.S. Campbell
deertongue cv. 'Tioga'	<i>Dichanthelium clandestinum</i> (L.) Gould
fox sedge	<i>Carex vulpinoidea</i> Michx. var. <i>vulpinoidea</i>
gamagrass cv. 'Meadowcrest', 'Pete'	<i>Tripsacum dactyloides</i> (L.) L.
Indiangrass cv. 'Rumsey'	<i>Sorghastrum nutans</i> (L.) Nash
little bluestem cv. 'Aldous'	<i>Schizachyrium scoparium</i> (Michx.) Nash var. <i>scoparium</i> <i>Schizachyrium scoparium</i> (Michx.) Nash var. <i>divergens</i> (Hack.) Gould
shallow sedge = lurid sedge	<i>Carex lurida</i> Wahlenb.
rattlesnake managrass	<i>Glyceria canadensis</i> (Michx.) Trin.
common rush = soft rush = lamp rush	<i>Juncus effusus</i> L. var. <i>conglomeratus</i> (L.) Engelm. <i>Juncus effusus</i> L. var. <i>decipiens</i> Buchenau <i>Juncus effusus</i> L. var. <i>pylaei</i> (Laharpe) Fernald and Wiegand <i>Juncus effusus</i> L. var. <i>solutus</i> Fernald and Wiegand
switchgrass cv. 'Blackwell', 'Shelter'	<i>Panicum virgatum</i> L. var. <i>virgatum</i> <i>Panicum virgatum</i> L. var. <i>spissum</i> Linder
woolgrass	<i>Scirpus cyperinus</i> (L.) Kunth

- (f) **Wildflower Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

- (1) **Purity.** Species shall be 98 percent purity or greater, with 75 percent germination or greater, and with weed and/or other crop seed content of 2.5 percent or less by weight. After review and approval by the Engineer, seed that does not conform to purity requirements may be used at increased seeding rates, or with measures to compensate for increased weed or crop seed content.
- (2) **Origin.** Any State of the United States.

(2) **Species.** Seed shall conform to the following species, subspecies, varieties, and cultivars:

WILDFLOWER SEED SPECIES	
COMMON NAME and CULTIVARS	SCIENTIFIC NAME
firewheel = annual gaillardia	<i>Gaillardia pulchella</i> Foug. <i>Gaillardia pulchella</i> Foug. var. <i>pulchella</i>
blackeyed Susan	<i>Rudbeckia hirta</i> L. var. <i>hirta</i> <i>Rudbeckia hirta</i> L. var. <i>pulcherrima</i> Farw.
calendula	<i>Calendula officinalis</i> L.
lemon beebalm	<i>Monarda citriodora</i> Cerv. ex Lag.
garden cosmos = pink cosmos cv. 'Sensation'	<i>Cosmos bipinnatus</i> Cav.
doubtful knight's-spur = rocket larkspur	<i>Consolida ajacis</i> (L.) Schur
Siberian wallflower	<i>Erysimum</i> × <i>marshallii</i> (Henfr.) Bois
Moroccan toadflax = Spurred Snapdragon	<i>Linaria maroccana</i> Hook. f.
common sunflower cv. 'Autumn Beauty'	<i>Helianthus annuus</i> L.
garden cornflower = bachelors button	<i>Centaurea cyanus</i> L.
sulphur cosmos = yellow cosmos cv. 'Bright Lights'	<i>Cosmos sulphureus</i> Cav.

(g) **Shrub Seed.** Seed shall be supplied in lots of individual species, unmixed, and conform to the following:

(1) **Purity.** Weed and/or other crop seed content shall be 0.5 percent or less by weight. Minimum purity and minimum germination shall conform to the requirements of (3), below.

(2) **Origin.** Refer to Section 920.06.06(d)(2).

(3) **Species.** Seed shall conform to the following species, subspecies, and varieties:

SHRUB SEED SPECIES		
SPECIES Including Subspecies and Variety	PURITY Min %	GERM Min %
American black elderberry <i>Sambucus nigra</i> L. ssp. <i>canadensis</i> (L.) R. Bolli	98	60
American cranberrybush <i>Viburnum opulus</i> L. var. <i>americanum</i> Aiton	99	70
black chokeberry <i>Photinia melanocarpa</i> (Michx.) K.R. Robertson and Phipps	99	70
bristly locust <i>Robinia hispida</i> L. var. <i>fertilis</i> (Ashe) R.T. Clausen <i>Robinia hispida</i> L. var. <i>hispida</i>	99	90
chokecherry <i>Prunus virginiana</i> L. var. <i>viginiana</i>	99	70

SHRUB SEED SPECIES		
SPECIES Including Subspecies and Variety	PURITY Min %	GERM Min %
common buttonbush <i>Cephalanthus occidentalis</i>	98	60
common ninebark <i>Physocarpus opulifolius</i> (L.) Maxim., orth. cons.	99	75
common winterberry <i>Ilex verticillata</i> (L.) A. Gray	99	60
desert false indigo <i>Amorpha fruticosa</i> L.	98	70
fragrant sumac <i>Rhus aromatica</i> var. <i>aromatica</i>	99	85
gray dogwood <i>Cornus racemosa</i> Lam.	99	70
inkberry <i>Ilex glabra</i> (L.) A. Gray	98	60
mapleleaf viburnum <i>Viburnum acerifolium</i> L.	99	70
nannyberry <i>Viburnum lentago</i> L.	99	75
red chokeberry <i>Photinia pyrifolia</i> (Lam.) K.R. Robertson and Phipps	85	60
red elderberry <i>Sambucus racemosa</i> L. var. <i>racemosa</i>	95	70
redosier dogwood <i>Cornus sericea</i> L. ssp. <i>sericea</i>	99	70
silky dogwood <i>Cornus amomum</i> Mill.	98	70
smooth sumac <i>Rhus glabra</i> L.	99	80
southern arrowwood <i>Viburnum dentatum</i> L. var. <i>dentatum</i> <i>Viburnum dentatum</i> L. var. <i>venosum</i> (Britton) Gleason <i>Viburnum recognitum</i> Fernald	99	70
spicebush <i>Lindera benzoin</i> (L.) Blume var. <i>benzoin</i>	95	60
staghorn sumac <i>Rhus typhina</i> L.	99	85
steepleshbush <i>Spiraea tomentosa</i> L.	85	70
swamp rose <i>Rosa palustris</i> Marsh.	99	65
witch hazel <i>Hamamelis virginiana</i> L.	99	70

920.06.07 Seed Mixes. Refer to Sections 920.06.01 through .06 and the document ‘Specifications for Seed and Seed Mixes’ maintained by the MdSHA Landscape Operations Division, which includes lists of approved cultivars.

(a) Turfgrass Seed Mix.

TURFGRASS SEED MIX		
MIX %	SPECIES	
	Common Name	Scientific Name
90	tall fescue	<i>Schedonorus phoenix</i> (Scop.) Holub
5	Kentucky bluegrass	<i>Poa pratensis</i> L. ssp. <i>pratensis</i>
5	perennial ryegrass	<i>Lolium perenne</i> L. ssp. <i>perenne</i>

(b) Special Purpose Seed Mix.

SPECIAL PURPOSE SEED MIX		
MIX %	SPECIES	
	Common Name	Scientific Name
75	hard fescue	<i>Festuca brevipila</i> Tracey
20	Chewings fescue	<i>Festuca rubra</i> L. ssp. <i>fallax</i> (Thuill.) Nyman
5	Kentucky bluegrass	<i>Poa pratensis</i> L. ssp. <i>pratensis</i>

(c) Temporary Seed Mix.

TEMPORARY SEED MIX		
MIX %	SPECIES	
	Common Name	Scientific Name
95	common wheat, winter type	<i>Triticum aestivum</i> L.
	common barley, winter type	<i>Hordeum vulgare</i> L.
	common oat, winter type	<i>Avena sativa</i> L.
	cereal rye, winter type	<i>Secale cereale</i> L.
5	foxtail bristlegrass = foxtail millet	<i>Setaria italica</i> (L.) P. Beauv.

920.07 PLANT MATERIALS.

920.07.01 Certificate and Licenses. Sellers, distributors, installers or producers of nursery stock shall possess the Plant Dealer License, Plant Broker License, or Nursery Inspection Certificate of the Maryland Department of Agriculture, or substitute a similar certificate or licenses from another State where they do business.

920.07.02 Plant Material Inspection. Plant material will be inspected for conformance with Sections 920.07.03 through .05, and tagged with MdSHA Plant Material Inspection Seals (Seals) as follows:

(a) Inspection. The Plant Material Inspection will be conducted in Maryland at the nursery where the plant material is grown, or at the brokerage where the plant material is sold.

When a nursery located outside of Maryland produces plant material, the Inspection will be conducted at the Contractor's holding area, or at the project site before planting, unless otherwise specified in the Contract Documents.

The Contractor shall ensure that the plant material is present for inspection on the scheduled date, and that it meets the requirements of Section 920.07. The condition and identity of plant material will be subject to re-inspection for the duration of the Contract.

(b) Scheduling. The Engineer will schedule the inspection. At least 14 days notice to schedule an inspection within Maryland, and at least 45 days notice to schedule an inspection outside Maryland.

(c) Seals. The County will determine which plants, if any, will be tagged with seals.

When seals are placed upon representative plants within a block of plant material, the plant material delivered for installation shall be similar in size, shape and character to the plant material that received seals.

Plant material that is delivered with broken or missing seals, or that is not similar to the plant material within the block that was tagged with seals will be rejected.

(d) Rejected Plants. Plant materials that do not meet these requirements will be rejected. Plant material rejected at the nursery or holding area shall not be delivered to the project; if delivered, it shall immediately be removed.

Plants shall not be installed until the Plant Material Inspection has been completed and satisfactory identification has been provided.

920.07.03 Plant Material Standards. Plant material shall be grown, identified, graded, and delivered in good condition as specified in this section.

(a) Hardiness Zones of Origin. Plant material shall be nursery grown within plant hardiness zones 5, 6, or 7 according to the '*USDA Plant Hardiness Zone Map*' unless otherwise specified. Plant material shall be dug and transported in conformance ANSI Z60.1. Bare root deciduous plants shall be delivered in a dormant condition. Roots shall be adequately protected and kept moist.

(b) Names and Identification. Refer to Section 920.06.01. Tags or labels identifying the grower or distributor shall clearly and correctly identify all plant material. Plant materials that are misidentified, or not satisfactorily tagged or labeled, or do not conform to the accepted characteristics of the species or cultivar, will be rejected.

(c) ANSI Standards. Plant material shall conform to *American Standard for Nursery Stock* (ANSI Z60.1) of the American Nursery and Landscape Association. Plant grades shall be those established in ANSI Z60.1, and shall include plants from that

size up to but not including the next larger grade size. When specimen plants are specified by the Contract documents, the specimen requirement shall also be met. The Engineer shall reject plant material that does not meet the standards of this section.

- (d) Health and Sanitation.** Plant material shall be in good health and be declared and certified free from disease and insects as required by law for transportation, and shall be free from pest-related stress and pest damage.

Plants shall be healthy, free from physical defects and stresses, and have well-developed branches and a vigorous root system. Plants that exhibit wilt, shriveling, insufficient root mass, broken or loose root balls, or inadequate protection will be rejected.

Container grown plants shall be well rooted, vigorous and established in the size pot specified, shall have well balanced tops for their pot size, and shall not be root bound.

Plants grown in fields or containers that include Ailanthus, Canada thistle, Johnsongrass, or yellow nutsedge will be rejected.

- (e) Shade and Flowering Trees.** Shade and flowering trees shall be symmetrically balanced. Major branch unions shall not have ‘V’ shaped crotches, bark inclusion or unions derived from water sprouts (epicormic growth) capable of causing structural weakness.

Trees shall be free of unhealed branch removal wounds greater than 1 in. diameter, or wounds or scars caused by staking, wire or ties, or any other defect that could cause structural failure or disfigurement.

Shade trees and central leader flowering trees shall have a single main trunk. Trunk height to the lowest branch shall conform to the following:

HEIGHT TO LOWEST BRANCH	
CALIPER in.	HEIGHT ft
1-1/2 and 1-3/4	4
2 to 2-1/2	5
3	6

- (f) Unacceptable Plants.** Plant material that becomes unacceptable after installation shall be rejected as specified in Section 710.03.18.

920.07.04 American Holly (*Ilex opaca* Aiton). Each lot of plants shall include 90 percent female plants and 10 percent male plants of cultivars selected from the following:

AMERICAN HOLLY CULTIVARS		
FEMALE		MALE
Angelica	Miss Helen	David
Arlene Leach	Old Heavy Berry	Jersey Knight
B and O	Patterson	Leather Leaf
Dan Fenton	Satyr Hill	Nelson West
Jersey Princess	Wyetta	North Wind

920.07.05 Plant Storage and Handling. Adequate facilities shall be provided for plant storage. Plants shall be handled with care to avoid damage.

- (a) **Bulbs.** Bulbs shall be stored under appropriate climate control.
- (b) **Annual Plants.** Annual plants shall be kept moist.
- (c) **Bare Root Plants.** Bare root plants shall be kept moist and heeled into moist soil or other suitable material until installed. During transport, the roots shall be covered with canvas, burlap or straw.
- (d) **Balled and Burlapped and Container Grown Plants.** Balled and burlapped plants and container grown plants shall be kept moist and installed within seven days of delivery, or the root balls or containers shall be covered with mulch or straw until removed for installation.

920.08 MARKING AND STAKING MATERIALS.

920.08.01 Outline Stakes. Outline stakes shall be full cut 1.75 x 1.75 in. sound hardwood, 48 in. long, as approved.

920.08.02 Stakes. Stakes for supporting trees shall be rough sawn, straight grain hardwood reasonably free from bark, knot holes, excessive warping, or other imperfections. Stakes shall be full cut 2.0 x 2.0 in. thickness.

920.08.03 Wire. Wire shall be No. 12 and 14 gauge new annealed galvanized wire.

920.08.04 Wire Rope. Wire rope shall be 0.25 in. zinc coated steel wire seven strand as commonly used for guying large trees.

920.08.05 Cable Clamps. Cable clamps shall be zinc-galvanized steel.

920.08.06 Hose. Hose shall be 5/8 in. inside diameter corded synthetic rubber hose.

920.08.07 Turnbuckles. Turnbuckles shall be zinc galvanized with 4.5 in. openings and 5/16 in. threaded ends with screw eyes.

920.08.08 Anchors. Tree anchors shall be earth anchors of a type commonly used for anchoring large trees.

920.09 WATER, PESTICIDES, AND ADJUVANTS.

920.09.01 Water. Water used for the installation and establishment of vegetation shall not contain concentrations of substances that are harmful to plant growth.

Water derived from public and municipal water systems in Maryland shall be acceptable for irrigation, fertilization, or mixing with pesticides. Water derived from wells or other sources may be used when it has soluble salts concentration less than 500 ppm, sodium less than 50 percent of total salts, and pH between 5.0 and 7.8.

920.09.02 Seed Carrier. Seed carrier shall be one or more inert, horticultural-grade materials used to improve seed mixing and distribution through a spreader or drill. Seed carriers shall be free flowing, easily mixable with seed, and nontoxic to seed, plants, humans, and wildlife. Seed carrier shall include one or more of the following:

- (a) **Calcined Clay.** Calcined clay shall be a furnace-baked clay product.
- (b) **Cocoa Shell.** Cocoa shell shall be processed cocoa seeds.
- (c) **Oyster Shell.** Oyster shell shall be crushed shells of oyster or other mollusk.
- (d) **Vermiculite.** Vermiculite shall be heat-expanded mineral mica.
- (e) **Perlite.** Perlite shall be heat-expanded mineral perlite.

920.09.03 Pesticides. Pesticides shall be EPA-approved and registered for use in Maryland to control plants, fungi, insects or other pests. Pesticides shall be approved for use, and acceptable application rates established as follows:

- (a) **Herbicide.** Herbicide shall control or prevent re-growth of plants or vegetation.
- (b) **Insecticide.** Insecticide shall control or protect against insect or other arthropod pests.
- (c) **Fungicide.** Fungicide shall control or protect against fungal or bacterial pests.
- (d) **Other Pesticides.** Other pesticides shall control or protect against other pests.

920.09.04 Marking Dye. Marking dyes shall be used to color spray solutions, be non-phytotoxic, oil or water soluble, and compatible with the pesticide products they are applied with. Marking dye products and their applicable application rates shall be established by the Contractor and approved by the Engineer.

920.09.05 Spray Adjuvant and Wetting Agent. Spray adjuvant and wetting agents shall be mixable with water and compatible with the pesticides or other products they are applied with.

920.09.06 Antidesiccant. Antidesiccant and antitranspirant products shall be materials that provide a film over plant surfaces to limit water loss. These products and their applicable application rates shall be established by the Contractor and approved by the Engineer.

SECTION 921 – MISCELLANEOUS

921.01 WATER FOR CONCRETE MIXES. Water shall conform to the pH requirements of T 26, Method B and shall be clear. If questionable quality is suspected, the water shall conform to the limits of the comparison tests with distilled water as specified in T 26. The chloride concentration of water used in mixing and curing of Portland cement concrete shall be determined in conformance with D 512 and shall not exceed the following limits:

Bridge Superstructure and Prestressed Concrete	500 ppm
Latex Modified Concrete	50 ppm
Other Concrete and Water Used in Curing	1000 ppm

921.02 MOISTURE AND DUST CONTROL AGENTS.

921.02.01 Calcium Chloride. Solid calcium chloride shall conform to M 144, Type S, Grade I, Class A. Calcium chloride in solution shall contain a minimum of 30 percent salts. The solution shall be made using potable water in a quantity designated by the Engineer. When analyzed on a dry basis in conformance with MSMT 601, the residue shall conform to M 144.

921.02.02 Magnesium Chloride. Flakes shall meet the following:

TEST PROPERTY	SPECIFICATION LIMITS
Magnesium Chloride MgCl ₂ , %	46.0 – 47.0
Calcium Chloride CaCl ₂ , %	2.0 – 3.0
Potassium Chloride KCl, %	0.5 – 1.0
Sodium Chloride NaCl, %	0.5 – 1.0
Sulfates, % max	0.05

When used as a solution, that solution shall contain 30 to 32 percent solids.

921.03 LIME.

921.03.01 Hydrated lime shall conform to the chemical requirements of C 206, Type N when used in finishing or C 207, Type N when used for masonry.

921.03.02 Hydrated lime for soil stabilization shall have a minimum combined calcium oxide and magnesium oxide content of 65 percent when tested in conformance with C 25 and shall conform to the following gradation:

SIEVE SIZE	PERCENT RETAINED max
3/8 in.	0
No. 30	3
No. 200	25

921.03.03 Quicklime shall have a combined calcium oxide and magnesium oxide content of 75 percent minimum and a gradation of 100 percent passing the 3/8 in. sieve when tested in conformance with C 25.

921.04 EPOXY ADHESIVES. Epoxy resin bonding material shall consist of a thermosetting epoxy resin and a hardener. The individual components of mixed epoxy shall not settle or skin and contain no volatile solvents, lumps or foreign materials. The epoxy shall conform to C 881. Unless otherwise specified, epoxy adhesive used for bearing and expansion pads shall be non-sagging.

The manufacturer shall furnish certification as specified in Section GP-1.05. The certification or data sheet shall show actual test results for each required property of the type, grade and class of epoxy submitted, and shall accompany each sample.

The manufacturer shall supply actual bond test results for each batch submitted for use.

921.05 STRUCTURAL TIMBER AND LUMBER. The manufacturer shall furnish certification as specified in Section GP-1.05. Structural timber and lumber shall conform to M 168.

921.06 TIMBER PRESERVATIVES. Preservatives and pressure treatment for timber shall conform to M 133.

921.07 CONDUITS. Conduit shall conform to the following:

921.07.01 Metallic Conduit.

MATERIAL	SPECIFICATION
Electrical Metallic Tubing	UL 797
Intermediate Metal Conduit	UL 1242
Rigid Metal Conduit	UL 6
Rigid Steel Conduit, Zinc Coated	ANSI C80.1

MATERIAL	SPECIFICATION
Metallic Outlet Boxes	UL 514A
Fittings for Conduit and Outlet Boxes	UL 514B

921.07.02 Nonmetallic Conduit. The manufacturer shall furnish certification as specified in Section GP-1.05. Each length shall be stamped or embossed with the grade or type and applicable UL or NEMA designation.

MATERIAL	SPECIFICATION
Schedule 40 and 80 Rigid Polyvinyl Chloride (PVC) Conduit	UL 651
Electrical Plastic Tubing (EPT) and Electrical Plastic Conduit (EPC-40 and EPC-80)	NEMA TC 2
Nonmetallic Outlet Boxes, Flush Device Boxes and Covers	UL 514C
Electrical Nonmetallic Conduit (ENC)	NEMA TC 13
PVC Fittings for use with Rigid PVC Conduit and Tubing	NEMA TC 3
Flexible PVC Coated Conduit	UL 360
Liquid Tight Flexible Nonmetallic Conduit for Detector Sleeves	UL 1660

921.07.03 PVC Coated Metallic Conduit. PVC externally coated, galvanized, rigid steel conduit and electrical metallic tubing shall conform to NEMA RN 1.

921.08 STRAW BALES. Straw bales for erosion and sediment control shall conform to the Contract Documents and shall be approximately 14 x 18 x 36 in.

921.09 GEOTEXTILES.

921.09.01 Geotextile Requirements. All geotextiles shall be listed in the National Transportation Product Evaluation Program (NTPEP) for geotextiles. The geotextile shall be manufactured from fibers consisting of long chain synthetic polymers, composed of a minimum 95 percent by weight of polyolefins or polyesters. The fibers shall be formed into a stable network so that the filaments or yarns retain their dimensional stability relative to each other, including selvages. The geotextile shall meet the following:

MARYLAND APPLICATION CLASS	TYPE OF GEOTEXTILE	GRAB STRENGTH lb D 4632	PUNCTURE STRENGTH lb D 6241	PERMITTIVITY sec ⁻¹ D 4491	APPARENT OPENING SIZE, max mm D 4751	TRAPEZOID TEAR STRENGTH lb D 4533
TYPE I	NONWOVEN	160	56	0.5	0.43	55

MARYLAND APPLICATION CLASS		TYPE OF GEOTEXTILE	GRAB STRENGTH lb D 4632	PUNCTURE STRENGTH lb D 6241	PERMITTIVITY sec ⁻¹ D 4491	APPARENT OPENING SIZE, max mm D 4751	TRAPEZOID TEAR STRENGTH lb D 4533
SD		WOVEN, MONOFILAMENT	250	90	0.5	0.43	90
	SD	TYPE II	NONWOVEN	160	56	0.2	0.25
		WOVEN, MONOFILAMENT	250	90	0.2	0.25	90
PE	TYPE I	NONWOVEN	200	80	0.7	0.43	80
		WOVEN, MONOFILAMENT	250	90	0.7	0.43	90
	TYPE II	NONWOVEN	200	80	0.2	0.25	80
		WOVEN, MONOFILAMENT	250	90	0.2	0.25	90
	TYPE III	NONWOVEN	200	80	0.1	0.22	80
		WOVEN, MONOFILAMENT	250	90	0.1	0.22	90
SE		NONWOVEN	200	80	0.2	0.3	80
		WOVEN	250	90	0.2	0.3	90
ST		WOVEN	300*	110	0.05	0.15**	110
F		WOVEN	100	–	0.05	0.6	–
E		NONWOVEN	90	30	0.5	0.3	30

Note 1: All property values are based on minimum average roll values in the weakest principle direction, except for apparent opening size.

Note 2: The ultraviolet stability shall be 50 percent after 500 hours of exposure for all classes, except Class F, which shall be 70 percent (D 4355).

* Minimum 15 percent elongation.

** This is a MINIMUM apparent opening size, not a maximum.

APPLICATION TYPES

SD = Subgrade Drainage

SE = Separation

E = Filter Covering

PE = Permanent Erosion Control

ST = Stabilization

F = Silt Fence

Only those geotextiles that have been tested by NTPEP will be considered candidates for use. In addition, the geotextiles shall meet the Contract Documents and the Geotextile Acceptance and Quality Assurance Procedure, MSMT 732.

Geotextiles used for reinforcement applications shall have a separate approval process.

921.09.02 Seam and Overlap. D 4884. When geotextiles are joined by sewing, the geotextile seam shall meet the following:

- (a) Seams shall be either “J” or “Butterfly” type and shall utilize a lock stitch.
- (b) Seams shall meet the tensile strength requirements for the geotextile when tested across the seam.

(c) The durability of the thread for seaming shall be at least equal to the geotextile itself.

921.09.03 Securing Pins or Staples shall be a minimum 10 in. length and be designed to securely hold the geosynthetic in place during construction.

921.10 RESERVED.

921.11 RAPID HARDENING CEMENTITIOUS MATERIALS FOR CONCRETE PAVEMENT REPAIRS. Materials shall be a dry, packaged cementitious mortar having less than 5 percent by weight of aggregate retained on the 3/8 in. sieve and shall conform to the following requirements:

Classification.

Class I - For use at ambient temperatures below 50 F.

Class II - For use at ambient temperatures of 50-90 F.

Class III - For use at ambient temperatures above 90 F.

Chemical Requirements. The material shall conform to the chemical requirements of C 928 and contain no organic compounds such as epoxy resins or polyesters as the principal binder.

Physical Requirements. The material shall conform to the following when tested in conformance with MSMT 725:

TEST	METHOD
Apparent Opening Size	D 4751
Grab Tensile Strength	D 4632, Grab Test – 4 in. x 8 in. specimen, 1 in. x 2 in. clamps; 12 in./minute strain rate both principal directions of geotextile.
Burst Strength	D 3786

Bond Strength, 7 days, psi min.	2000
Length change, increase after 28 days in water, based on length at 3 hr, % max	+0.15
Length change, decrease after 28 days, % max.	-0.15
Freeze-Thaw, loss after 25 cycles in 10% CaCl ₂ solution, % max.	8
Initial setting time, minutes min.	10

Marking. All packages delivered to the project shall be marked with the following information:

- (a) Date material was packaged.
- (b) Approximate setting time.
- (c) Recommended dosage of water or liquid component.
- (d) Mixing instructions.
- (e) Class or temperature range.

Certification. The manufacturer shall furnish certification as specified in Section GP-1.05

showing the actual test results for each class and type of material submitted to the Laboratory.

921.12 DAMPPROOFING AND WATERPROOFING MEMBRANE. The adhesive side of the membrane shall be protected with a special release paper that can be easily removed for installation. The membrane shall conform to the following requirements:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Grab tensile strength, lb/in at 12 in./minute rate of loading, min.	D 1682	70
Pliability, 180 degree bend, 1 in. mandrel @ 20F	D 146	Unaffected
Resistance to puncture, lb min.	E 154 (square mounting frame method)	40
Permeance, perm max.	E 96 Method B	0.1
Weight, oz/sq.yd min.	D 3776	40
Primer	-	As specified by the manufacturer

Roll and sheet waterproofing membrane may be accepted on certification. The manufacturer shall furnish certification as specified in Section GP-1.05 with actual test results showing that the material conforms to these Specifications.

921.13 PREFORMED FIBERGLASS. Meet the following:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Density, g/cm, min	D 792	1.25
Absorption, % max	D 570	1.0
Tensile Strength, average of five specimens each direction*, psi min	D 638	10 000
Thickness (unless otherwise specified), in.	—	3/16
Thickness Tolerance, in.	—	+1/16, -0
Color No.	Fed. Std. 595	26622

* Longitudinal and transverse directions.

SECTION 922 – PREFABRICATED EDGE DRAINS

922.01 CERTIFICATION. The manufacturer shall furnish certification as specified in Section GP-1.05.

922.02 PREFABRICATED EDGE DRAINS shall be flexible, rectangular conduit consisting of supporting drainage core encased in a geotextile.

Drainage Core. Material shall be manufactured from polymers having a high resistance to deterioration by pavement deicing salts, petroleum based materials, and naturally occurring soil chemicals. The core shall have sufficient flexibility to withstand bending and handling without damage or significant weakening.

The core geotextile contact point spacing for post and cusped (having a point or a pointed end) sheet type cores shall not exceed 1.125 in. Elongated pipe core sections shall have a 7.5 in./ft minimum open area to allow lateral flow into the core. Cores with support on only one side shall have a minimum of 5 percent of the area of that support side in unobstructed flow. Drainage core shall meet the following requirements:

TEST PROPERTY	TEST METHOD	SPECIFICATION LIMITS
Thickness, in. min	—	0.75
Compressive Strength, psi, @ 20% maximum deformation, min	(a)	40
In-plane Flow Rate, gal/min/ft of width, min	D 4716 (b)	15

- (a) D 5034 for crushed sheet and post type cores.
D 2412 for elongated pipe type cores.
- (b) 10 psi load after 100 hr at a hydraulic gradient of 0.1.

Geotextile Wrap. Section 921.09, Class SD, Type II.

The fabric shall be bonded to contact points of supporting core for post and cusped sheet type cores to ensure that the geotextile does not sag into the core flow area. The geotextile shall be tightly stretched over the core for elongated pipe type cores.

922.03 FITTINGS. Fittings for the pavement edge drain systems, including, but not limited to end seals, splices, outlets, and shunts shall meet the manufacturer’s recommendations and be of sufficient strength to withstand construction handling and permanent loading. All fittings shall be as approved.

922.04 OUTLET PIPE. Pipe for outlets shall be 6 in. minimum diameter and meet the requirements of Section 905.

SECTION 923 – SLURRY SEAL

923.01 AGGREGATES. Aggregates shall be crushed stone, compatible with the emulsion, and shall meet the requirements of Section 901.

923.02 MINERAL FILLER. Section 901.

923.03 EMULSIFIED ASPHALT. M 208, Grade CSS-1h. The cement mixing test is waived.

Emulsified asphalt shall not separate before placement of SS or LMSS.

923.04 LATEX MODIFIED EMULSION. The latex modifier and other emulsifiers shall be milled into the asphalt cement. The emulsified asphalt shall be modified by the addition of 3.0 ± 0.4 percent latex solids by weight of the asphalt. The latex modifier shall be an unvulcanized styrene butadiene rubber (SBR) or 100 percent natural latex in liquid form. The manufacturer shall furnish certification as specified in Section GP-1.05 showing actual test results meeting these Specifications.

923.05 MIX DESIGN APPROVAL. Mix design data shall be submitted to the Engineer for approval at least three weeks in advance of the paving operation. The mix design shall list the ingredients and their proportions as well as the gradation of the proposed aggregate.

The SBR latex modifier shall meet the following:

TEST PROPERTY	SPECIFICATION LIMITS
Styrene butadiene Ratio	24:76 \pm 1.5
Solids Content, % min	60
pH, max	6.2
Weight Per Gallon, Wet Basis @ 25 C, lb min Dry Basis @ 25 C, lb min	7.9 4.5

Latex modified emulsion CSS-1h shall meet M 208 modified as follows:

The 100 percent natural latex shall be a high ammonia natural latex meeting D 1076, Type I.

The mix design report shall show test results meeting the following:

TEST PROPERTY	SPECIFICATION LIMITS
MSMT 403, Mixing Test, minutes min	2
MSMT 403, Setting Time, minutes max	30
MSMT 403, Water Resistance	Slight Discoloration
MSMT 403, Wet Track Abrasion, g/sq.ft. max	75
International Slurry Seal Association (ISSA) TB 139, Set Time Test, 30 minutes, kg/cm min	12

The percent of residual asphalt, based on the dry aggregate weight, shall be between 8.0 and 12.5 for Type II Mix and 7.0, and 11.0 for Type III Mix, each having a control tolerance of \pm 1.0 percent.

The Contractor shall submit sufficient material for testing the mix design whenever the Engineer requires corroborating information.

RESIDUE REQUIREMENTS	
TEST PROPERTY	SPECIFICATION LIMITS
Penetration @ 25 C, min	30
Ductility @ 25 C, min	150
@ 4 C, min	100
R and B Softening Point, F, min	140
Cement Mixing Test	Waived

The latex modified emulsion, after standing undisturbed for 24 hours, shall be a uniform color throughout.

923.06 MIX DESIGN. The stability shall be a minimum of 1800 lb and the flow shall be 0.06 to 0.16 in. when tested per T 245, Modified (modification permits air drying of the mixture at 70 to 75 F for a minimum of 24 hours, followed by placement in a 140 F oven and drying to a constant weight prior to reheating and placing in molds).

SECTION 924 – RESERVED

SECTION 925 – DETECTABLE WARNING SURFACES

925.01 GENERAL. The detectable warning surface shall conform to the most recent accessibility guidelines of the Americans with Disabilities Act (ADA). The Division of

Construction Contracts Administration will maintain a list of pre-qualified products, from which a surface shall be selected. Prior to inclusion on the list of products, the manufacturer shall submit test results, to the Engineer, showing conformance to the table of physical properties as specified in Section 925.06. In addition, the manufacturer shall submit complete conforming physical property test results in six-month intervals, beyond the date of the original prequalification testing. Materials shall meet certification requirements prior to use on a project. Submit the proposed source of supply, and specific product, to the Engineer, for approval.

925.02 COMPOSITION. The surface shall be either flexible or rigid. The Engineer shall be notified of any changes to the composition of a prequalified detectable warning product. In this case, the manufacturer shall re-submit complete test results showing conformance to the table of physical properties as specified in Section 925.06.

925.03 SIZE. The detectable warning surface shall be 24 in. min. wide in the direction of pedestrian travel, and extend the full width of the curb ramp, landing, or blended transition.

925.04 CONFIGURATION AND DIMENSIONS. The surface shall consist of a system of truncated domes, aligned in conformance with, and meeting the dimensional requirements of the most recent ADA accessibility guidelines. Each dome shall have a base diameter of 0.9 in. to 1.4 in. a top diameter of 50 to 65 percent of the base diameter, minimum, to 65 percent of the base diameter, and a height of 0.2 in. Arrange the truncated domes in a square grid with center-to-center spacing of 1.66 in. to 2.35 in.

925.05 COLOR. Detectable warning product shall contrast with adjoining surfaces in conformance with current ADA requirements. The color shall be homogenous throughout the surface.

925.06 PHYSICAL PROPERTIES. The detectable warning surface shall meet the following requirements:

PROPERTY	TEST METHOD	SPECIFICATION LIMIT
Slip Resistance Coefficient	C 1028 (dry method)	.80 minimum
Abrasive Wear, index	C 501	150 minimum
Fade (UV) Resistance/Color Retention	G 151/ G 154 (Cycle1)	No fading or change in color after 3000 hours*
Chemical Stain Resistance	D 1308**	No discoloration or staining
Freeze/Thaw Resistance	C 1026	No disintegration
Adhesion/Bond Strength	C 482	No adhesion failure

PROPERTY	TEST METHOD	SPECIFICATION LIMIT
Contrast	Contrast percentage formula*** using E 1349 to determine cap Y brightness/light reflectance values (LRV)	Current ADA requirement****

*Chromaticity coordinates (CIE system) checked per E 1349, before and after test.

**Immersion Test for acid solution, soap solution, and detergent solution reagents. Spot Test, Open for salts, lubricating oils and greases. Tests shall be conducted at 77 F for durations of 16 hrs.

***Contrast % = $[(B1 - B2)/B1] \times 100$,

where B1 = (LRV) of the lighter area, and B2 = (LRV) of the darker area.

****For the purpose of determining whether a material meets acceptable contrast criteria, inserting cap Y brightness of detectable warning surface, and assume a value of 15 for the cap Y brightness of cured concrete, to determine percentage difference. When a detectable warning surface is to be installed on any material other than cured concrete, additional testing will be required to ensure the contrast requirements are met.

925.07 CERTIFICATION. The manufacturer shall furnish certification stating that the detectable warning surface meets all Maryland State Highway Administration specification requirements, and that the surface meets the most recent ADA accessibility guidelines.

With the exception of test results, the certification shall be as specified in Section GP-1.05.

SECTIONS 926 Through 949 – RESERVED

SECTION 950 – TRAFFIC CONTROL-RELATED MATERIALS

950.01 PRECAST CONCRETE TRAFFIC BARRIER, as specified in the Contract Documents. Welded wire fabric as specified in Section 908.05.

950.02 RESERVED.

950.03 REFLECTORIZATION OF SIGNS AND CHANNELIZING DEVICES. Unless otherwise specified in the Contract Documents, retroreflective sheeting for signs shall meet the requirements given in Sections 950.03.01, .02, or .03. When yellow type III, IV, VI, VII,

or IX, is specified in the Contract Documents, fluorescent yellow shall be used. Retroreflective sheeting for channelizing devices shall meet the requirements given in Sections 950.03.01, .02, .03, .04, or .06.

Sign sheeting shall be selected from the QPL. All Retroreflective Sheeting shall meet D 4956.

Sign legend and background sheeting shall be from the same sheeting manufacturer.

950.03.01 Type III Retroreflective Sheeting, per D 4956, Type III and the following:

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE III SHEETING Minimum Coefficient of Retroreflection (R_A) $cd/(lx \cdot m^2)$							
Observation Angle°	Entrance Angle°	White	Yellow	Red	Blue	Green	Brown
0.2	+40	100	60	18	7	15	3
0.5	+40	60	45	10	7	10	2.5

950.03.02 Type IV Retroreflective Sheeting, per D 4956, Type IV and the following:

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE IV SHEETING Minimum Coefficient of Retroreflection (R_A) $cd/(lx \cdot m^2)$ E-810 (Average of 0 and 90 degrees Orientation)							
Observation Angle°	Entrance Angle°	White	Yellow	Red	Green	Blue	Orange
.2	+40	120	80	16	12	9	29
0.5	+40	55	40	10	8	4	14
1.0	+40	9	8	1	0.8	0.5	1

950.03.03 Type IX Retroreflective Sheeting, per D 4956 Type IX, and the following:

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE IX SHEETING Minimum Coefficient of Retroreflection (R_A) $cd/(lx \cdot m^2)$ Per ASTM E-810 (Average of 0 and 90 degrees Orientation)								
Observation Angle°	Entrance Angle°	White	Yellow	Fluor. Yellow	Fluor. Yellow Green	Red	Green	Blue
0.2	+40	90	70	55	75	26	9.8	4.5

MINIMUM REFLECTIVE INTENSITY VALUES FOR TYPE IX SHEETING Minimum Coefficient of Retroreflection (R_A) $\text{cd}/(\text{lx} \cdot \text{m}^2)$ Per ASTM E-810 (Average of 0 and 90 degrees Orientation)								
Observation Angle°	Entrance Angle°	White	Yellow	Fluor. Yellow	Fluor. Yellow Green	Red	Green	Blue
0.5	+40	35	27	15	23	10	3.5	1.5
10.	+40	10	8.8	6	8	3	1.6	0.8

950.03.04 Temporary Traffic Signs (TTS).

- (a) All rigid temporary traffic signs shall be fluorescent orange and meet D 4956, Type VII or Super High Efficiency, Full Cube Retroreflective Sheeting.
- (b) All temporary flexible rollup signs shall be fluorescent orange and meet D 4956, Type VI.

950.03.05 Black Sheeting, shall be nonreflective.

950.03.06 Drums for Maintenance of Traffic. per D 4956 Type VII.

950.04 Overhead Sign Structures. Structural steel shall meet A 709, Grade 36. Steel tubes or pipes shall meet A 595, Grade A or API 5-LX52. Design and minimum thickness of material shall meet AASHTO Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals. All steel shall be galvanized per A 123. Hardware shall be galvanized per A 153.

950.05 to 950.07 RESERVED.

950.08 SIGNS. The manufacturer or supplier shall furnish certification as specified.

950.08.01 Sheet Aluminum Sign Panels. B 209, with an anodized mill finish. Alloys shall be either 6061 T6 or 5052-H38.

950.08.02 Extruded Aluminum Sign Panels and Edge Strip. B 221, alloy 6063 T6.

950.08.03 Hardware shall be clear anodized, meeting of the following: B 209, alloy 2024 T4; or B 211, alloy 2024 T4, 6262 T9, 6061 T6, 7075 T6 or 2017 T4.

SECTION 951 – UNDERGROUND ELECTRICAL & DETECTION MATERIALS

951.01 BACKFILL MATERIAL FOR TRENCHES FOR BURIED CABLE. The lower 1 ft depth of trench shall be fine aggregate meeting Section 901. Material above the 1 ft depth shall be select material as specified in Section 916.

951.02 ELECTRICAL CABLE AND WIRE. A standard commercial product manufactured not more than one year prior to the date of the Contract. All cable and wire shall be made of copper.

951.02.01 Direct Burial Cable. A single conductor stranded, with an unshielded, chemically crosslinked thermosetting polyethylene insulation rated for 600 volts. The cable shall be suitable for direct earth burial or installation in ducts or conduit and shall meet UL Type USE, XHHW or THW and bear the applicable UL labels denoting type, size, stranding, manufacturer's name and surface marking or molded ridges for phase and neutral identification. Sizes shall be as specified.

951.02.02 Building Cable and Wire. 600 V, plastic insulated, nylon jacketed and shall meet UL Type THWN/THHN and bear the applicable UL labels denoting type, size, stranding, manufacturer's name and surface marking or molded ridges for phase and neutral identification. Sizes shall be as specified.

951.02.03 Cable Duct shall consist of cables preinstalled in either a polyvinyl chloride (PVC) or polyethylene (PE) plastic duct meeting NEMA TC 7 and the NEC. PVC shall meet D 3485. PE duct shall be manufactured from black, virgin, high density PE resin meeting D 1248, Type III, Grade P34, Class C, Category 5. Minimum inside diameter of duct shall be 1-1/2 in. Cable shall be rated for 600 volts.

951.02.04 Ground Wire and Rods. Ground wire shall be bare medium drawn copper. Ground wire shall be of the size (solid or stranded) configuration shown in the Contract Documents. Ground rods shall be 0.75 in. diameter, a minimum of 10 ft in length, with a steel core and copper jacket.

951.03 UTILITY DETECTION TAPE. Consists of one layer of aluminum foil laminated between two layers of inert plastic film. The foil shall be 3 in. wide with a tensile strength of 60 lb. The plastic film shall have a 4.5 mil minimum thickness.

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